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City of Helena
Municipal Waste Landfill

Post-Closure Plan

December 2009

Prepared by:

GreatWest engineering

Post-Closure Plan
for the
City of Helena
Municipal Waste Landfill

PREPARED FOR:

City of Helena Parks Department, Montana

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& Underground
Tank Management Bureau

December 2009

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GreatWest engineering

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CITY OF HELENA
MUNICIPAL WASTE LANDFILL
POST-CLOSURE PLAN

1. INTRODUCTION

This landfill closure plan is developed to comply with those stipulations stated in the State Solid Waste Rule ARM 17.50.530 and ARM 17.50.531.

The City of Helena Landfill is a Class II landfill located in Sections 19 and 30, T. 10N, R. 3W. The site is located between the 1200 and 1300 blocks of North Main Street, north of Lyndale Avenue, south of the Montana Rail Link line and Bill Roberts Municipal Golf Crouse, and east of Carroll College (see Figure 1, Appendix A.). The landfill is located within the Helena city limits, Lewis and Clark County, Montana. The landfill encompasses about 60 acres of landfill area.

A. OPERATING HISTORY OF LANDFILL

The Helena landfill is divided into three phases based on the operational history of the site. The oldest part of the landfill (Phase I) includes 27 acres, located at the southern half of the site. Phase II is approximately 10 acres in a wedge shape located between Phase I, Carroll College, railroad tracks and Phase III. The boundary between Phases I and II is occupied by an old railroad bed, which enters the site at the southwest and curves to the northeast. This railroad bed intersects another railroad bed in the northeast. Phase III covers approximately 24 acres along the north of the site. Phase III is bounded by Bill Roberts Golf Course, commercial property, Elk River Concrete, and Phase II. The City of Helena Waste Transfer Station, occupies the northwest corner of the Phase III area. Figure 2, Appendix A shows the existing site including the above described phases of the landfill.

The Helena landfill site was in operation from the late 1800's until 1994. Open burning was the primary disposal method until 1970. The landfill changed operations in 1970 to sanitary landfill practices and open burning ceased. Phase I was closed in the 1970's, with the post-closure activity including seven acres of land occupied by the YMCA and Montana National Guard Armory, and grassed park land. Phase II was in operation from

the late 1970's until approximately 1983. Phase III was activated in 1982, and was closed in 1997.

B. SITE GEOLOGY

The native material for this area is primarily unconsolidated clay, silt, sand, gravel and cobbles. This material is surrounded by igneous bedrock at Carroll College and limestone bedrock beneath the Armory building and the YMCA building.

2. CLOSURE AND POST CLOSURE REQUIREMENTS

State Solid Waste Rule ARM 17.50.530 and 17.50.531 requires the owner of the facility to have a written closure plan that addresses as a minimum the following items.

- A description of the final cover and the installation procedures
- An estimate of the largest area of Class II landfill unit ever requiring a final cover at any time during the active life.
- An estimate of the maximum inventory of wastes ever on site during the active life.
- A schedule for completing closure activities.
- Post-closure care shall include: maintaining the integrity of the and effectiveness of the final cover, maintaining and operating the leachate collection system, Monitoring the ground water, maintaining and operating the gas monitoring system.
- A description of the monitoring and maintenance activities.
- A description of the planned uses of the property during the post-closure period.

3. FINAL COVER SYSTEM

State Solid Waste Rule 17.50.530 (a) requires that owners of all Class II landfill units install a final cover system designed to minimize infiltration and erosion. The State rule requires the final cover system be designed and constructed to:

- Minimize infiltration through the closed unit by the use of an infiltration layer that contains a minimum 18 inches of earthen material and have a permeability less than or equal to the permeability of any bottom liner, barrier layer, or natural subsoils present, or a permeability no greater than 1 x 10-5 cm/sec, whichever is less;
- Minimize erosion of the final cover by the use of a seed bed layer that contains a minimum of 6 inches of earthen material that is capable of sustaining native plant growth and protecting the infiltration layer from frost effects and rooting damage; and
- Revegetate the final cover with native plant growth within 1 year of placement of the final cover. The department may approve alternative revegetation plant species or an extension in the time requirement for revegetation.

All current waste areas within the landfill have a natural bedrock and soil base. The entire site has been closed and capped in some manner. Phase III has been under the current State of Montana and Subtitle D regulations. This phase was closed with up to two feet of compacted clay. The other two phases (Phase I and II) were closed in accordance with previous State law at the time of closure. The closure caps consist of an indeterminate and variable thickness of native soils. Vegetative cover over the site varies.

4. ESTIMATE OF GROSS WASTE AREA/TOTAL WASTE INVENTORY

The landfill has an ultimate waste disposal area of approximately 60 acres. The landfill is closed and does not have remaining air-space available. The estimated total waste inventory is undetermined due to the inaccuracy of the landfill's records and age of the site.

5. FINAL LAND USE

The landfill area will be used for recreational park land including: a softball complex, soccer fields, multi-use areas, shelters, concession stands, restrooms, playgounds, volleyball courts, basketball courts, dog park, freeride park, bouldering area, walking trails, and parking lots. Figure 3, Appendix A shows the proposed master plan for Centennial park.

6. POST-CLOSURE OPERATION

Post-Closure operations are an extension of the applicable operation procedures of an active landfill. The post-closure period lasts 30 years after the closure of each unit. Use during this period will be recreational park land. Settlement will occur and the final cover will need to be periodically maintained. Surface and groundwater control systems will continue to function and roads and other facilities will be maintained. The groundwater monitoring system will be operated. The following plans will be followed for maintaining the facility through post-closure:

- Groundwater Monitoring will continue according to the Helena Landfill Closure Plan prepared by Hydrometrics in March 1993 for 30 years after closure.
- Methane Monitoring will continue for 30 years after closure according to the details outlined in the Helena Landfill Closure Plan prepared by Hydrometrics in March 1993.
- A groundwater extraction system is also in operations at the project site and will continue to operate as long as measurable concentrations of contaminants are being extracted.
- The landfill gas extraction systems will be operated throughout the post-closure period.
- The owner will remain the City of Helena through the post-closure operation of this facility.
- Yearly engineering inspection will be made at the closed facility to identify any repairs to the cap, cover and drainage systems which may be required. Yearly engineering inspections may be made by City engineering staff or subcontracted out to a consultant. The cost estimates of closure and post-closure should also be updated annually. This information will help determine the financial assurance requirements and subsequent payments.
- A notice will be posted with the deed at the Courthouse indicating that the land was used for a landfill.

A. Final Cover Maintenance

- Waste excavation in the park will be minimized as part of the proposed project (fill only, if possible). If waste is encountered it will be subexcavated to depth of 2 feet and the waste will be disposed of at a licensed Class II

Landfill. 18 inches of select fine grained material will be placed in the subexcavated area. GCL will be placed over the 18 inches then an additional 6 inches of select fine grained material free will be placed over the GCL.

- Structures and buildings will not be included in the first phase of the project; however, most buildings and structures will be located within the old railroad spur footprints so that these structures are not placed on waste areas. Building designs will include passive venting of landfill gas, methane monitoring in the building, and flex connections as possible on utilities for settling purposes. In the event waste is encountered during building construction, the waste will be removed within the building footprint to the extent practical, disposed of at a licensed Class II Landfill, and replaced with structural fill. Submittals of the building design plans and engineering details, including proposed vent system details and testing plans will be sent to the Montana DEQ for approval prior to commencement of construction activities.
- If penetrations to the cover in the form of post holes, poles, building foundations, etc. occur, the structures will be placed in concrete with 3"-4" of bentonite covering the concrete. This design will minimize the possibility of creating a landfill gas or water pathway. See Figure C-33, Appendix A.
- Utility trenches will be designed for shallow bury, with select fine grain bedding free of gravels (with appropriate pipe type) to minimize disturbance of waste, limit water pathways, and limit landfill gas pathways along pipe routes. If shallow bury is required, annual winterization of both water and sanitary services will be required. If waste disturbance is required the waste will be subexcavated to a depth of 12 inches (the removed waste will be disposed of at a licensed Class II Landfill). Place 12 inches of select fine grained material free of gravels in the subexcavated area. Approximately 18 inches below the surface (12 inches below subgrade) place a layer of GCL. See Figure C-33, Appendix A.
- When constructing the parking lots, minimal excavation will be required. The existing asphalt will be removed, select road base gravel material will be added to the subgrade, and new asphalt will be placed over the road base gravel. If waste is encountered during excavation, the cover will not be reestablished, however the select road base will be placed over the waste

and the asphalt will be placed over the subgrade. The asphalt is an impermeable layer, which is graded to drain water to the run-off control structures.

- There are several existing power poles on the property that will be removed. The holes left from the removal of the power poles shall be filled with a slurry of bentonite-cement to minimize water pathways and landfill gas pathways through these holes.
- Trees located in the waste areas will be placed on a berm to minimize root penetration of the landfill cover system. See Appendix C for details of various species of trees including root depths and irrigation requirements.
- Final cover areas will be inspected regularly (at least once a year) to ensure compliance with designated design function. Yearly final cover inspections are required and will be conducted by the City of Helena's engineering staff or subcontracted to a consultant.
- Final cover areas will be re-graded as necessary to prevent surface ponding that may result from differential settlement. Grading activities to level hummocky topography or to remove high spots will not be performed. Cutting of existing waste areas will only be performed during isolated utility/irrigation installations. Fill will be provided for low areas as to not cut into the existing surface.
- Final cover areas which have experienced erosion will be investigated to determine cause of erosion. The affected area will then be reseeded or treated with another appropriate erosion control method. Positive drainage will be established around the LFGES.

B. Drainage Maintenance

- The entire site will be graded so that all storm water will be drained into two storm water ditches. The storm water ditches drain into a lined storm water pond, which is located on the old railroad spur, off of the waste footprint, north of the proposed softball fields. See the 95% Construction Plans for details of the stormwater pond. The storm water pond is then piped into the city of Helena's storm water system.
- Irrigation of turf grass over waste areas will be allowed as long as the areas are not over-watered. All irrigation systems will include the capability to monitor weather conditions (evapotranspiration, rain, and wind sensors) to regulate the amount of irrigation minimizing saturation of soil and percolation of water through the waste. See Appendix B for an example of the proposed irrigation control system.
- Periodic inspections during dry weather will be performed to check the integrity of the system.
- During the wet season or following a measurable amount of precipitation, the surface water control structures should be inspected.
- Repairs will be made immediately to any damaged portions of the system. Repairs will be made to any sloughed or erosional areas with reshaping and re-grading conducted as necessary. Excavation in the waste will be avoided except for utilities and irrigation components.

C. Gas Vent & Groundwater Monitoring Maintenance

- The design will attempt to avoid or minimize any impacts to the existing Landfill gas extraction system. The Contractor will be required to verify the locations of the known LFGES components and repair all damage immediately if caused. Some adjustments to the elevations of the LFGES vaults will be required.
- During the first year, the facility will perform quarterly groundwater monitoring and monthly methane monitoring to evaluate the impact of the placement of additional final cover. The results of the evaluation will be provided to the Department in a report due no later than 90-days after the completion of this first year of data collection.

- The additional soil cover placed on the existing waste areas may possibly have impacts on landfill gas migration and groundwater. Once the project is constructed, the existing landfill gas and groundwater monitoring system performance will be evaluated to determine whether there are any issues that need to be mitigated as a result of the changes.
- A passive landfill gas venting system and methane monitoring system will be used on all enclosed buildings (concession/restroom building at softball complex, Shakespeare temporary structure, etc.) when they are constructed. No buildings are planned for Phase I constructions scheduled for the Summer of 2010.
- All monitoring wells that are impacted during construction shall be readjusted to the final grades, as appropriate.
- The covers on the existing gas venting system shall be reset to match the new grades surrounding the vents.
- Positive drainage will be made away from all vent and well locations.
- Vents and wells will be painted, marked or flagged in such a way that they are easily seen and identified.
- Monitoring wells impacted during construction and requiring repair or adjustment will be reported to the Department within 7 days of impact/repair.
- Immediate repairs shall be made to any wells or vents which may become damaged.

Appendix A

Figures

F:\1-08102-Centennial Park/Master Plan\CADD 1-08102\Exhibits\ClosurePostClosure\1-08102 Vicinity Map.dwg

T 10 N, R 3 W, SEC 30

0 500 1000
SCALE IN FEET

GreatWest engineering
2501 BELT VIEW DRIVE
HELENA, MT 59601
(406)449-8627

Figure # 1
Project Vicinity Map
Centennial Park Master Plan

CENTENNIAL PARK POST CLOSURE
CITY OF HELENA PARKS DEPARTMENT

Figure 2
Landfill Phases

CENTENNIAL PARK POST-CLOSURE
CITY OF HELENA PARKS DEPARTMENT

GreatWest engineering

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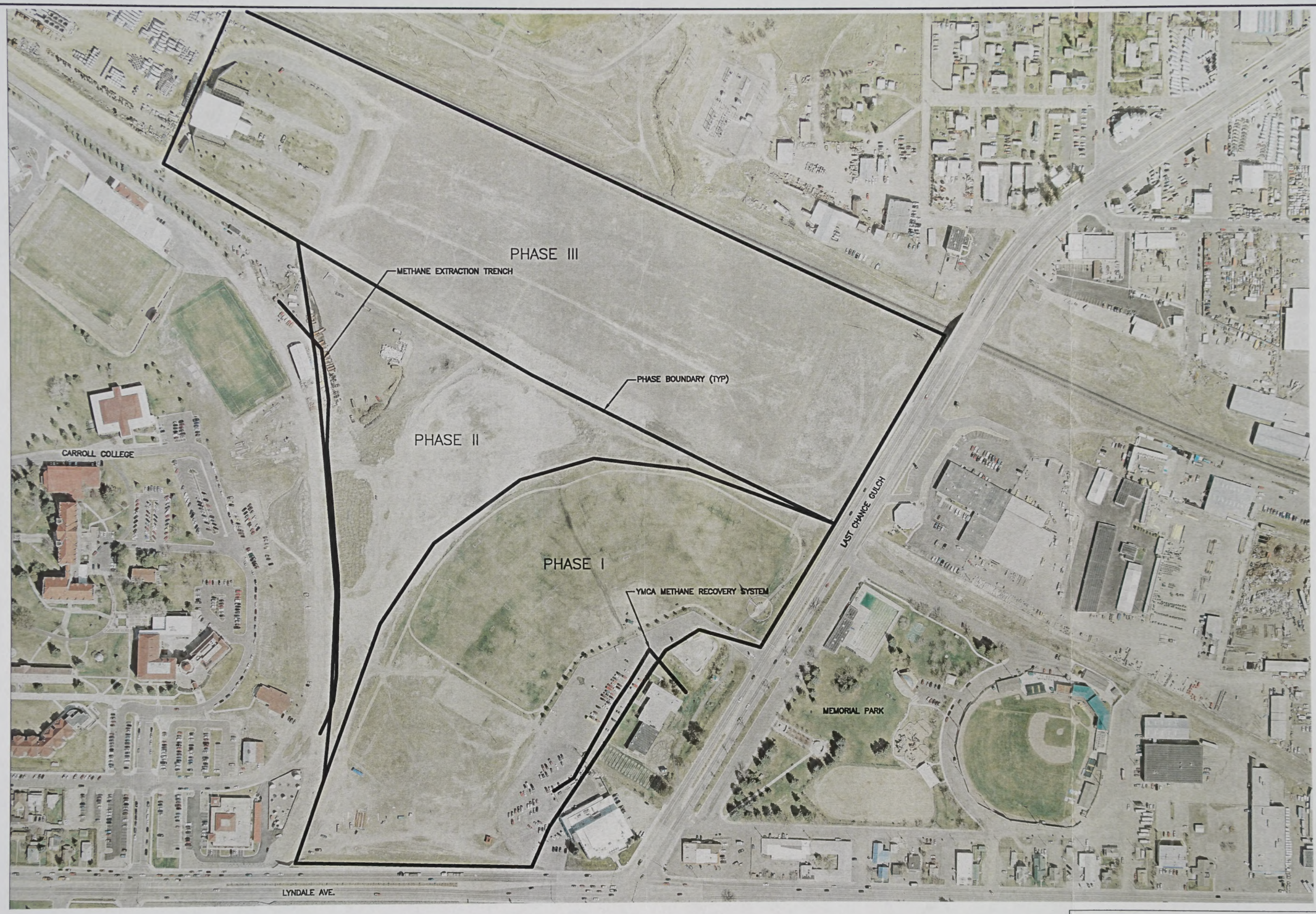

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Figure 2
Landfill Phases

CENTENNIAL PARK POST-CLOSURE
CITY OF HELENA PARKS DEPARTMENT

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Figure 3
Master Plan

CENTENNIAL PARK POST-CLOSURE
CITY OF HELENA PARKS DEPARTMENT

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NORTH

DOG PARK
TRAIL (TYP)
BOULDERING AREA
VOLLEYBALL COURTS
GRAVEL ACCESS ROAD/PARKING
BASKETBALL COURTS
DETENTION POND
FREERIDE PARK
SOFTBALL COMPLEX
RESTROOM /CONCESSION AREA
PLAYGROUND
SHELTER
SOCCER FIELD (TYP)
NORTH LAST CHANCE GULCH
PARKING (TYP)
LYNDALE AVE.

0 125 250
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GreatWest engineering

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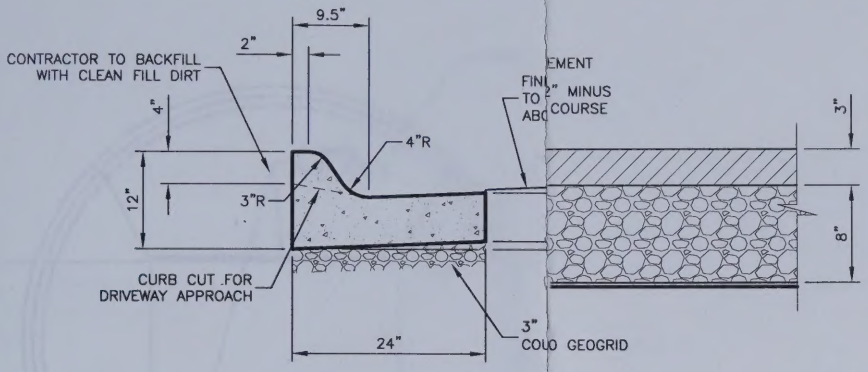
Figure 3
Master Plan

CENTENNIAL PARK POST-CLOSURE
CITY OF HELENA PARKS DEPARTMENT



AVEMENT SECTION

NOTES:
1. EXCAVATION REQUIRED FOR CURB AND GUTTER SHALL BE AND PAID FOR AS "STREET EXCAVATION" UNDER SECTION MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS, FOU
2. FOR NEW STREET CONSTRUCTION, EXTEND CRUSHED BASE BACK OF THE CURB. MINIMUM THICKNESS OF CRUSHED BENEATH CURB AND GUTTER SHALL BE 3". FOR CURB REPLACEMENT PROJECTS, PROVIDE A MINIMUM OF 3" OF COURSE BENEATH NEW CURB AND GUTTER.

1 / C-30 **CURB AND GUTTER DE**
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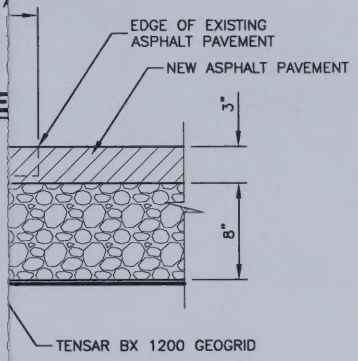

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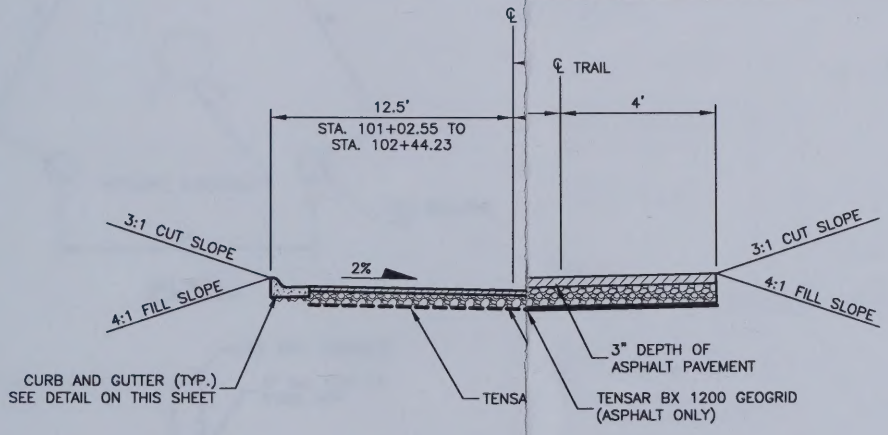

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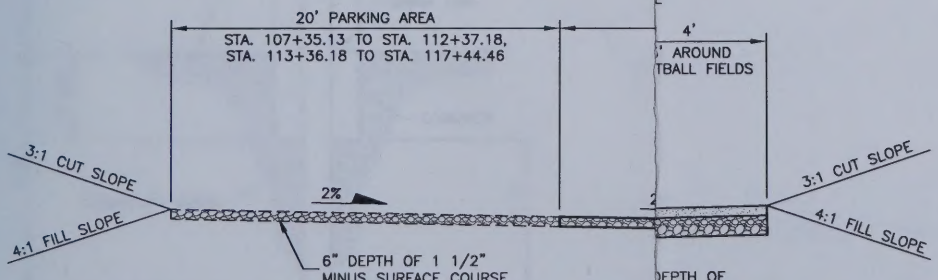

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TODD K PE
LICENSED PROFESSIONAL ENGINEER
PRELIMINARY

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Centennial Park - 95% Submittal

DETAILS

CARL THUESEN
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GOLF COURSE ARCHITECTURE
LANDSCAPE ARCHITECTURE
1925 GRAND AVE. SUITE 105
P.O. BOX 22943
BILLINGS, MT 59104
406/252-5545 FAX 245-9855

Drawn by:	BAA
Date:	11/18/09
Checked by:	TKK
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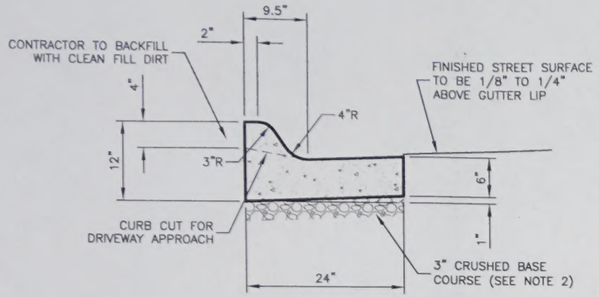

NOTES:
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2. FOR NEW STREET CONSTRUCTION, EXTEND CRUSHED BASE COURSE TO THE BACK OF THE CURB. MINIMUM THICKNESS OF CRUSHED BASE COURSE BENEATH CURB AND GUTTER SHALL BE 3". FOR CURB AND GUTTER REPLACEMENT PROJECTS, PROVIDE A MINIMUM OF 3" OF CRUSHED BASE COURSE BENEATH NEW CURB AND GUTTER.

1 C-30 CURB AND GUTTER DETAIL
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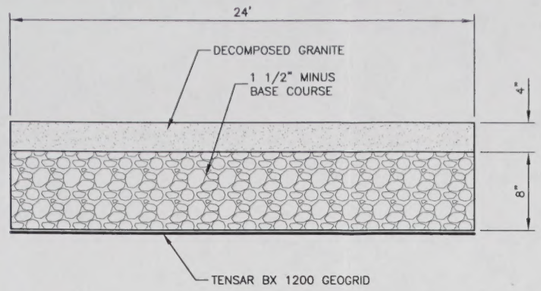

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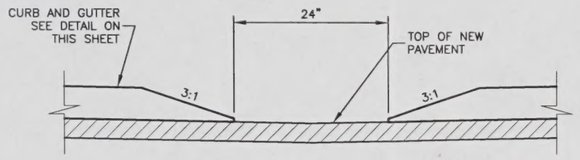

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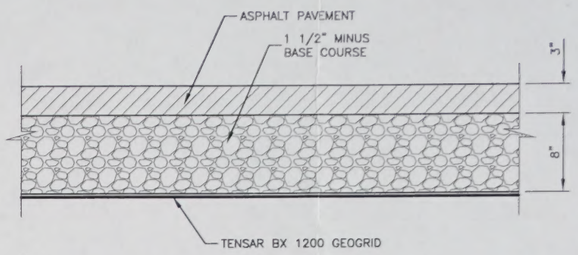

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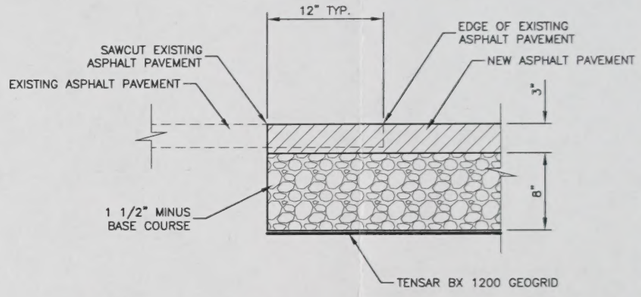

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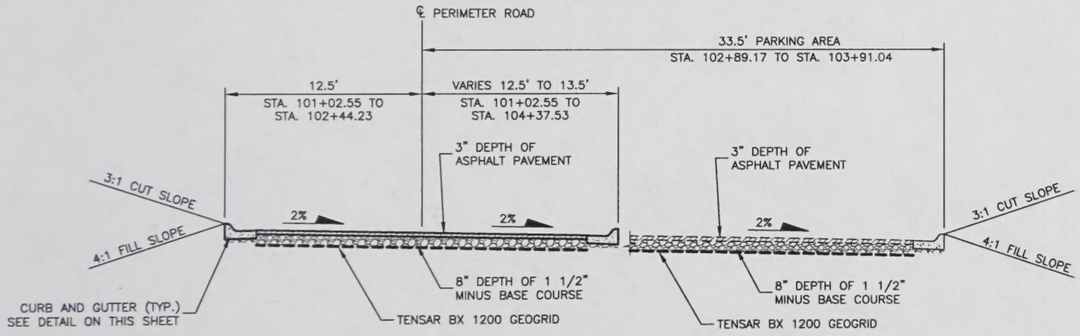

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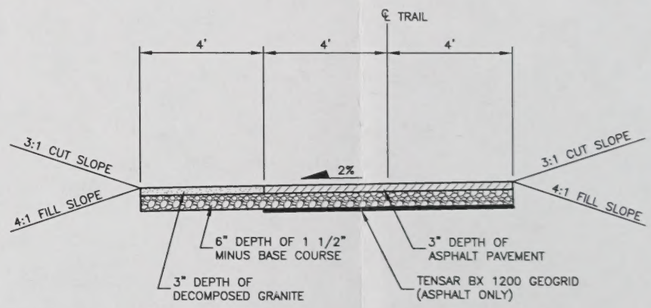

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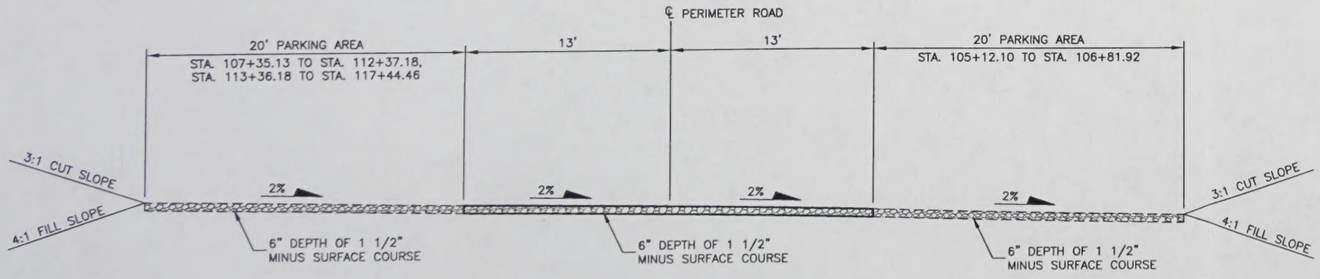

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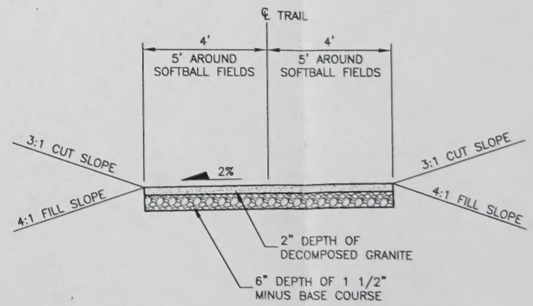

TYPICAL DECOMPOSED GRANITE TRAIL SECTION
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Stamp: MONTANA TODD KRAUSE PE 19 LICENSED PROFESSIONAL ENGINEER PRELIMINARY

Logo: GreatWest engineering
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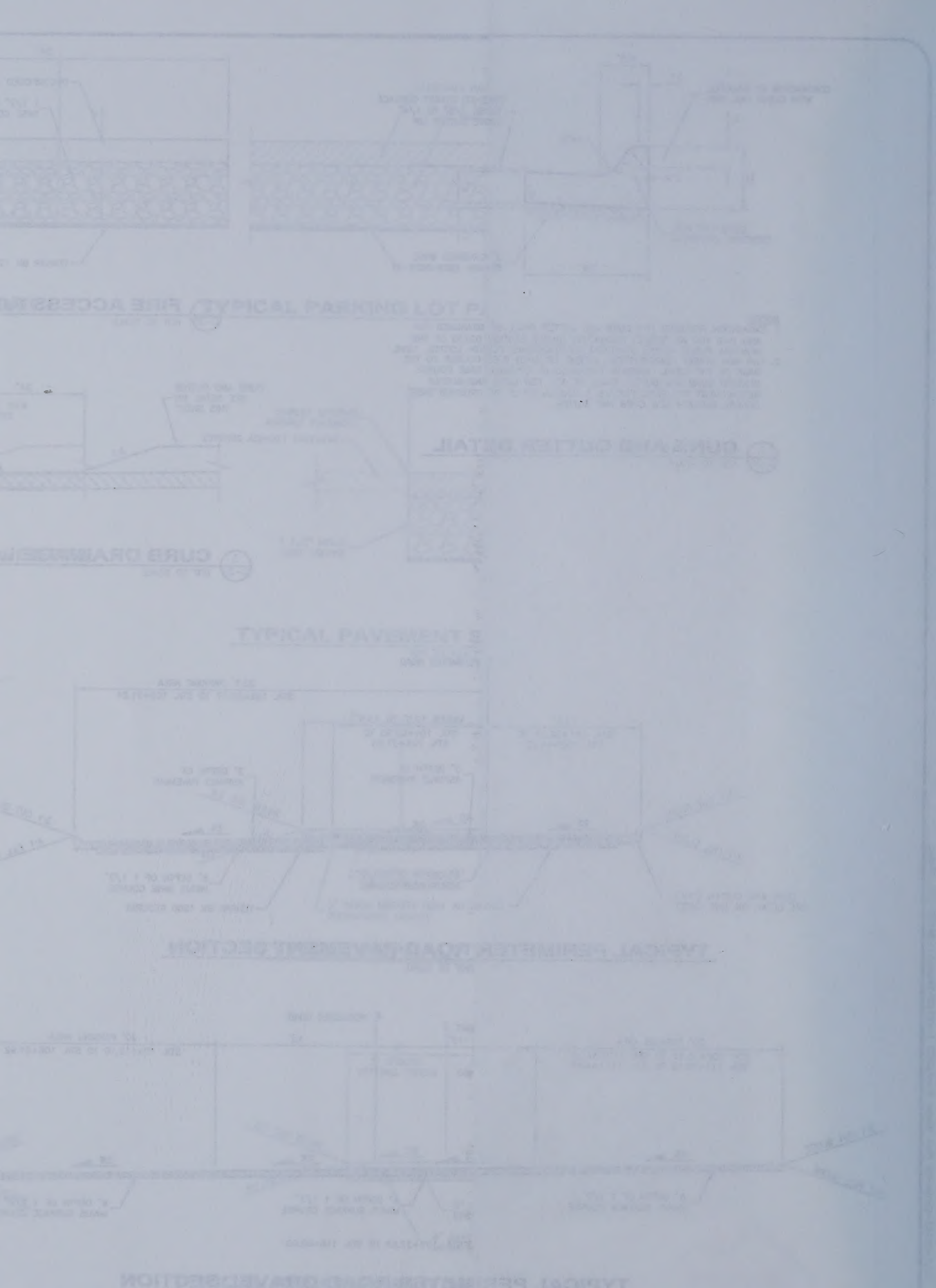

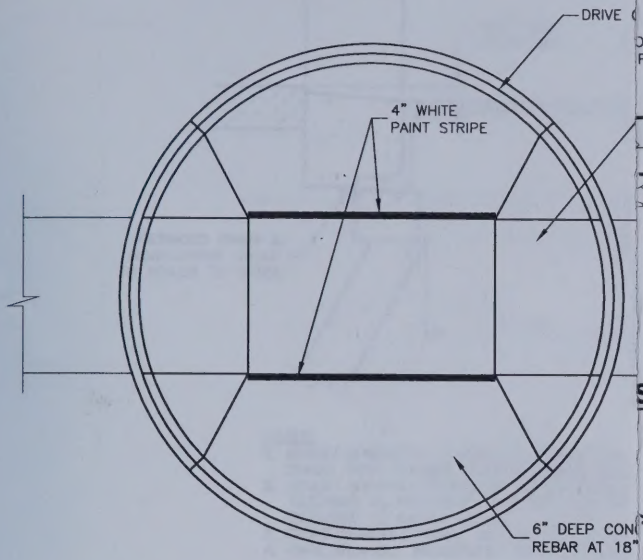

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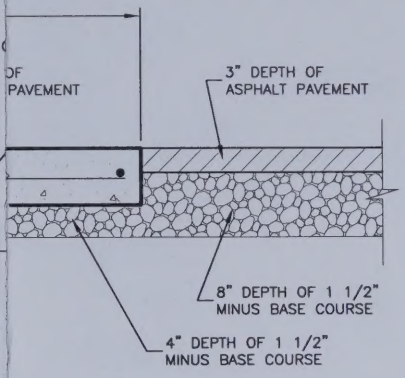

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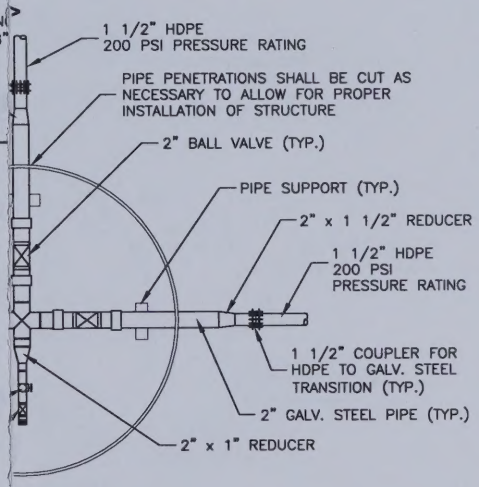

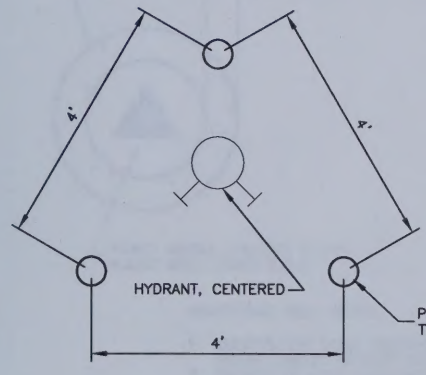

PLAN

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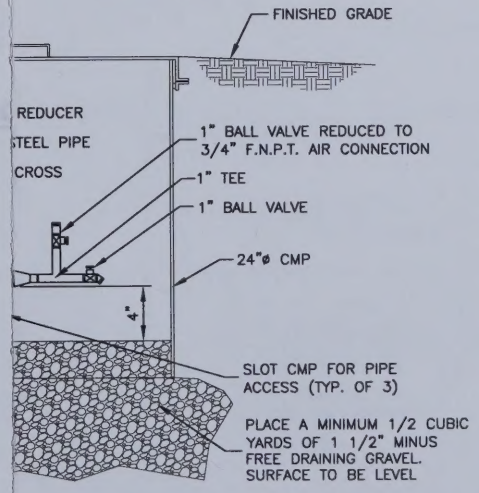

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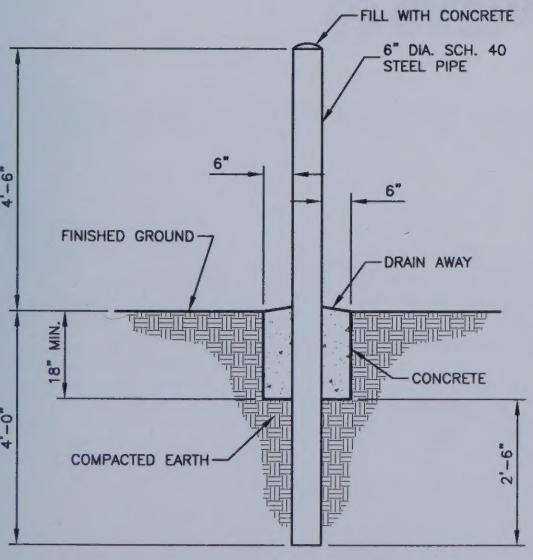

NOTE: PAINT ALL EXPOSED STEEL
YELLOW PER SPEC.

4 C-31 **PIPE BOLLARD DETAIL**
NOT TO SCALE

D FOR 24-INCH DIAMETER CORRUGATED METAL PIPE
APPROVED EQUAL. LID SHALL BE DESIGNED TO BE
S. IF BOLTED, ALL BOLTS SHALL BE STAINLESS

D TO UNDISTURBED SOIL OR HAVE 8" X 8" X 1/4"

ALVE BOX DETAIL

Stamp:
MONTANA
TODD
PE
LICENSED
PROFESSIONAL ENGINEER
PRELIMINARY

Logo:
GreatWest engineering
2501 BELT VIEW DRIVE
HELENA, MT 59601
(406)449-8627

Centennial Park - 95% Submittal

DETAILS

CARL THUESEN
A S L A
GOLF COURSE ARCHITECTURE
LANDSCAPE ARCHITECTURE
1925 GRAND AVE. SUITE 105
P.O. BOX 22943
BILLINGS, MT 59104
406/252-5545 FAX 245-9855

Drawn by:	BAA
Date:	11/18/09
Checked by:	TKK
Date:	11/18/09
Rev:	
Rev:	
File:	

SHEET
C-31

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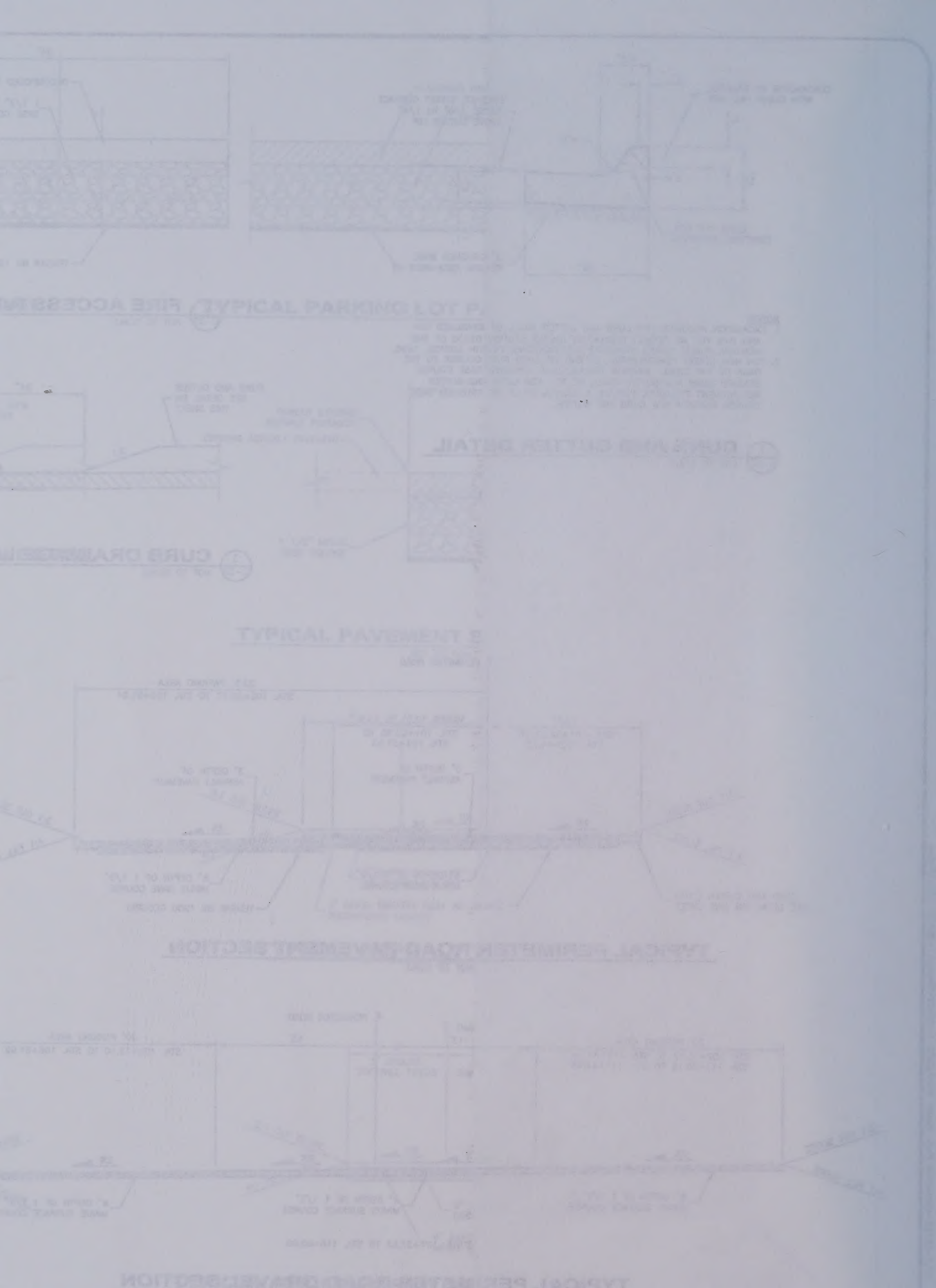
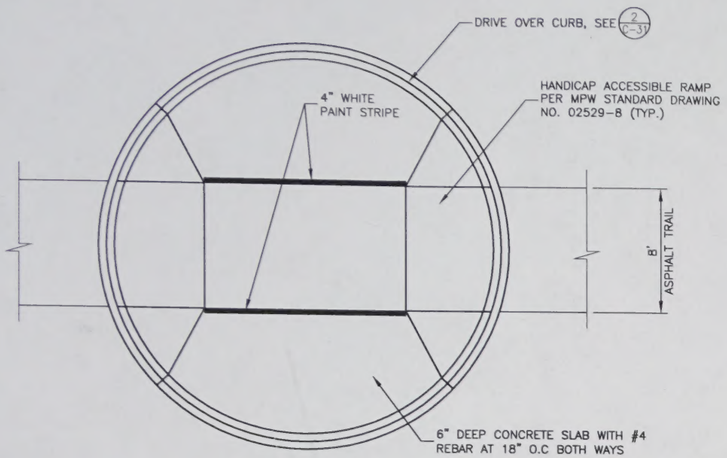
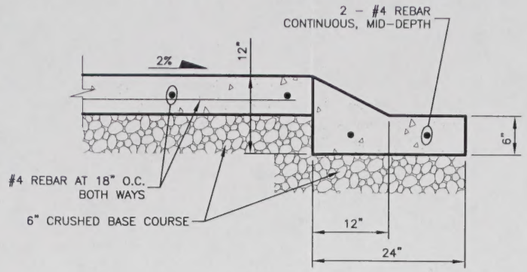
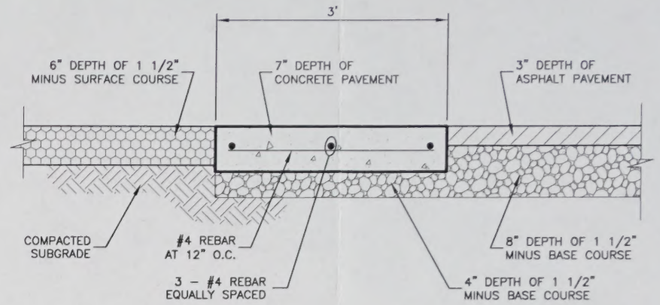




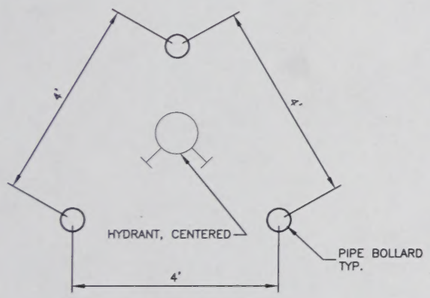
1/C-31 TRAFFIC CIRCLE DETAIL
NOT TO SCALE



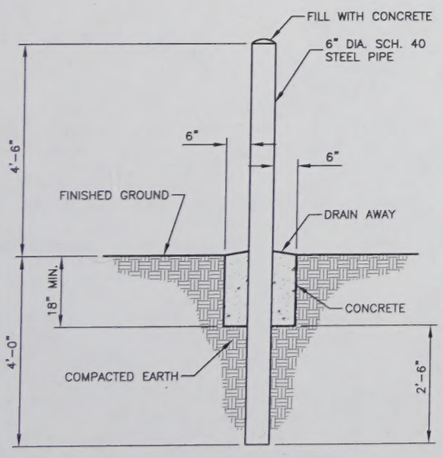
2/C-31 DRIVE OVER CURB DETAIL
NOT TO SCALE



3/C-31 CONCRETE TRANSITION STRIP DETAIL
NOT TO SCALE

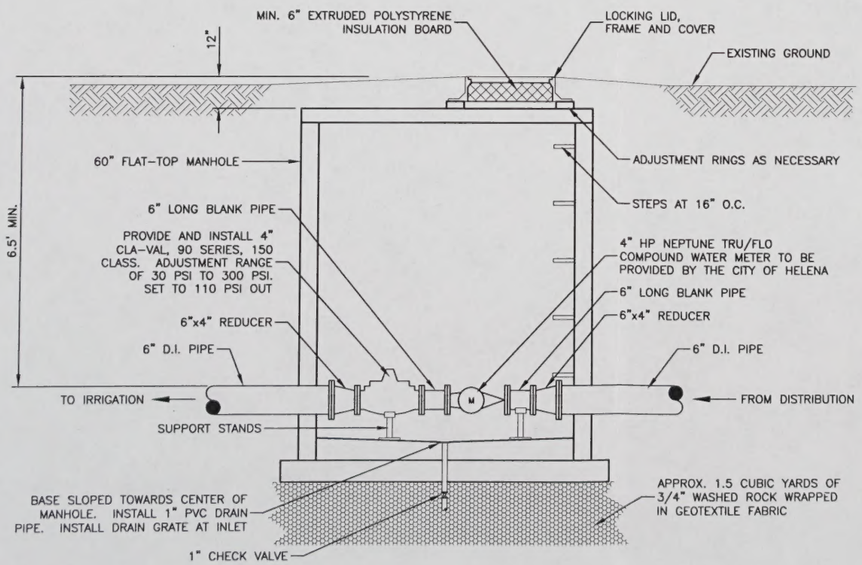


PLAN

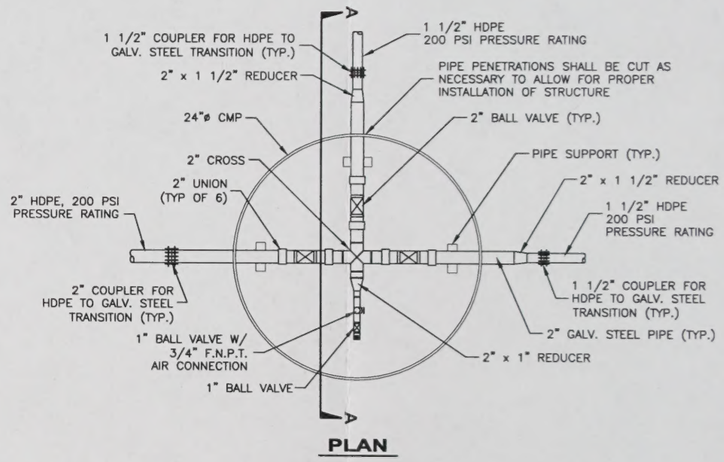


NOTE: PAINT ALL EXPOSED STEEL YELLOW PER SPEC.

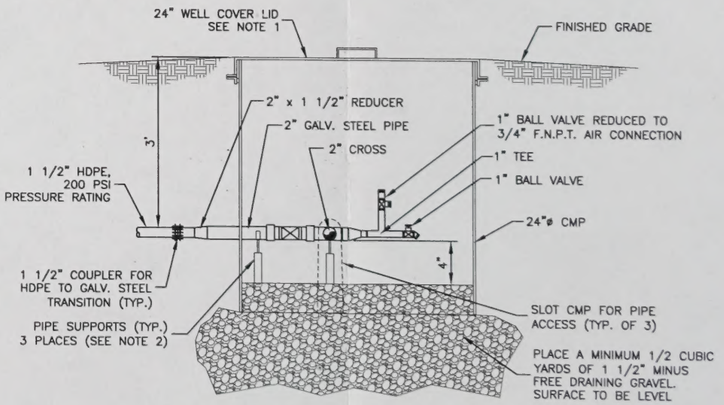
4/C-31 PIPE BOLLARD DETAIL
NOT TO SCALE



5/C-31 METER PIT DETAIL
NOT TO SCALE



PLAN



SECTION A-A

NOTES:

1. CONTRACTOR TO PROVIDE STEEL ACCESS LID FOR 24-INCH DIAMETER CORRUGATED METAL PIPE AS MANUFACTURED BY ROSCOE STEEL OR APPROVED EQUAL. LID SHALL BE DESIGNED TO BE SECURED BY BOLTING OR 2 LOCKING HASPS. IF BOLTED, ALL BOLTS SHALL BE STAINLESS STEEL. PAINT LID DARK BROWN.
2. PIPE SUPPORT BASES SHALL EITHER EXTEND TO UNDISTURBED SOIL OR HAVE 8" X 8" X 1/4" STEEL SUPPORT BASES TO SUPPORT PIPING.

6/C-31 BLOW-OUT VALVE BOX DETAIL
NOT TO SCALE

Stamp: MONTANA TODD KRISTOVICH 19 PE LICENSED PROFESSIONAL ENGINEER PRELIMINARY

Logo: GreatWest engineering 2501 BELT VIEW DRIVE HELENA, MT 59601 (406)449-8627

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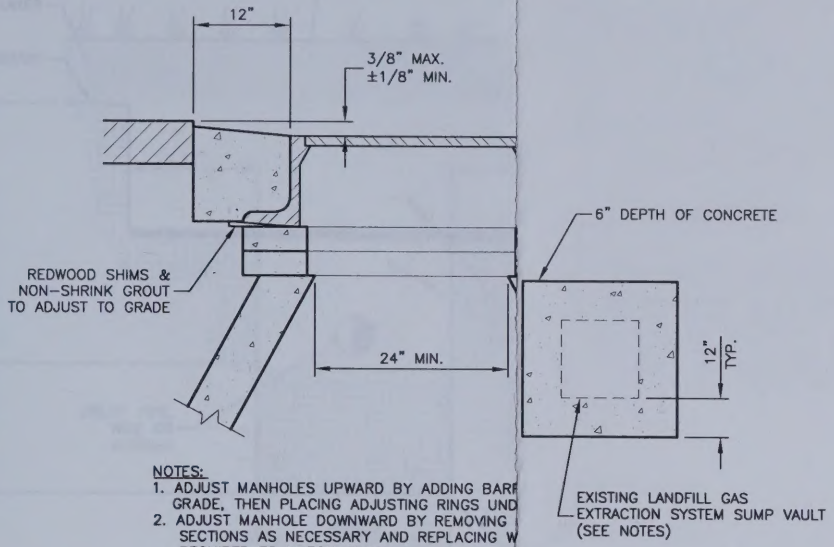
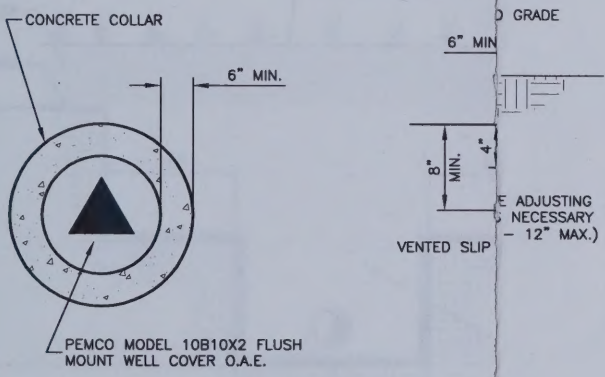


NOTES:
1. ADJUST MANHOLES UPWARD BY ADDING BARR
GRADE, THEN PLACING ADJUSTING RINGS UND
2. ADJUST MANHOLE DOWNWARD BY REMOVING
SECTIONS AS NECESSARY AND REPLACING W
REQUIRED TO MATCH GRADE.
3. SLOPE MANHOLE FRAME AS REQUIRED TO MA
4. FINAL MANHOLE ADJUSTMENT SHALL BE MAD

1 / C-32 **MANHOLE COVER ADJUSTMENT**
NOT TO SCALE

UMP ACCESS DETAIL
TO SCALE



MONITORING WELL NOTES:

1. CONTRACTOR SHALL REMOVE AND DISPOSE
MOUNT VAULTS WITHOUT DAMAGE OR CONT
2. DAMAGE OR CONTAMINATION SHALL RESULT
REPLACING THE WELL AT NO COST TO THE

4 / C-32 **MONITORING (CAPED AREA)**
NOT TO SCALE

Stamp:
MONTANA
TODD K
PE
LICENSED
PROFESSIONAL ENGINEER
PRELIMINARY

Logo:
GreatWest engineering
2501 BELT VIEW DRIVE
HELENA, MT 59601
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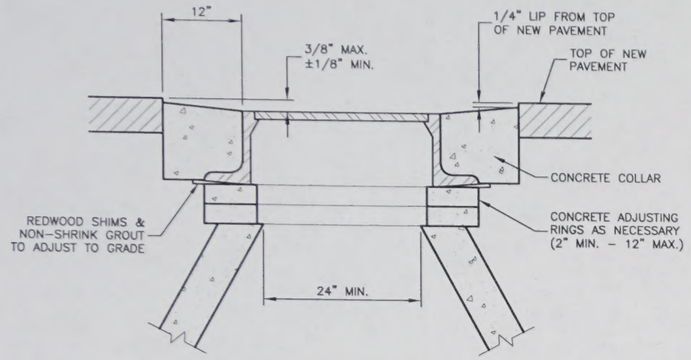
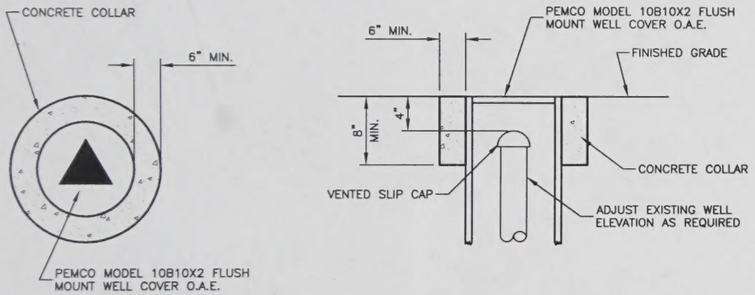


NOTES:
1. ADJUST MANHOLES UPWARD BY ADDING BARREL SECTIONS TO MATCH GRADE, THEN PLACING ADJUSTING RINGS UNDER FRAME.
2. ADJUST MANHOLE DOWNWARD BY REMOVING CONE AND BARREL SECTIONS AS NECESSARY AND REPLACING WITH SECTIONS OF LENGTH REQUIRED TO MATCH GRADE.
3. SLOPE MANHOLE FRAME AS REQUIRED TO MATCH SLOPE OF STREET.
4. FINAL MANHOLE ADJUSTMENT SHALL BE MADE AFTER PAVING.

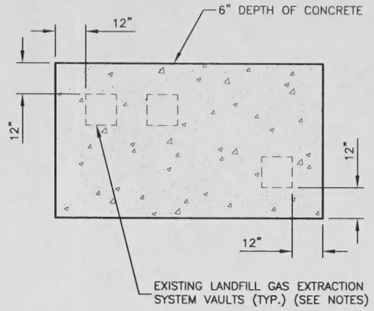
1 C-32 MANHOLE COVER ADJUSTMENT DETAIL (VEHICLE AREA)
NOT TO SCALE



MONITORING WELL NOTES:

1. CONTRACTOR SHALL REMOVE AND DISPOSE OF EXISTING WELL PROTECTOR FLUSH MOUNT VAULTS WITHOUT DAMAGE OR CONTAMINATION OF THE WELLS.
2. DAMAGE OR CONTAMINATION SHALL RESULT IN THE CONTRACTOR REPAIRING OR REPLACING THE WELL AT NO COST TO THE OWNER.

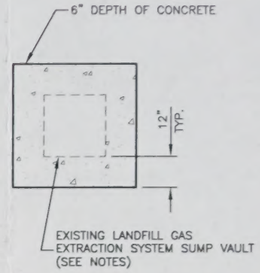
4 C-32 MONITORING WELL DETAIL
NOT TO SCALE



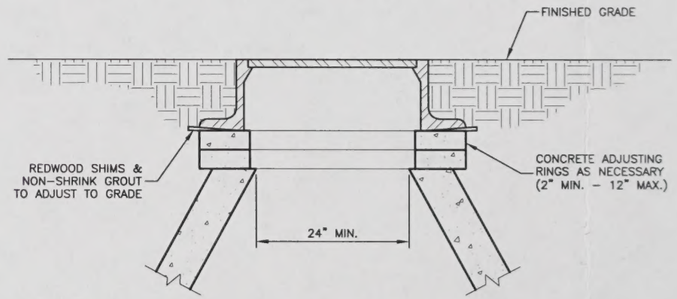
2 C-32 GAS EXTRACTION WELL DETAIL
NOT TO SCALE

GAS EXTRACTION AND SUMP VAULT NOTES:

1. CONTRACTOR SHALL REMOVE EXISTING CONCRETE AROUND EXISTING VAULTS, REMOVE AND SALVAGE EXISTING VAULTS, ADJUST VAULTS TO MATCH FINISHED GRADES, AND PLACE NEW CONCRETE AS SHOWN ON THE DRAWINGS.



3 C-32 SUMP ACCESS DETAIL
NOT TO SCALE



NOTES:
1. ADJUST MANHOLES UPWARD BY ADDING BARREL SECTIONS TO MATCH GRADE, THEN PLACING ADJUSTING RINGS UNDER FRAME.
2. ADJUST MANHOLE DOWNWARD BY REMOVING CONE AND BARREL SECTIONS AS NECESSARY AND REPLACING WITH SECTIONS OF LENGTH REQUIRED TO MATCH GRADE.

5 C-32 MANHOLE COVER ADJUSTMENT DETAIL (LANDSCAPED AREA)
NOT TO SCALE

Stamp: MONTANA TODD K. KLEMP PE LICENSED PROFESSIONAL ENGINEER PRELIMINARY

Logo: GreatWest engineering
2501 BELT VIEW DRIVE
HELENA, MT 59601
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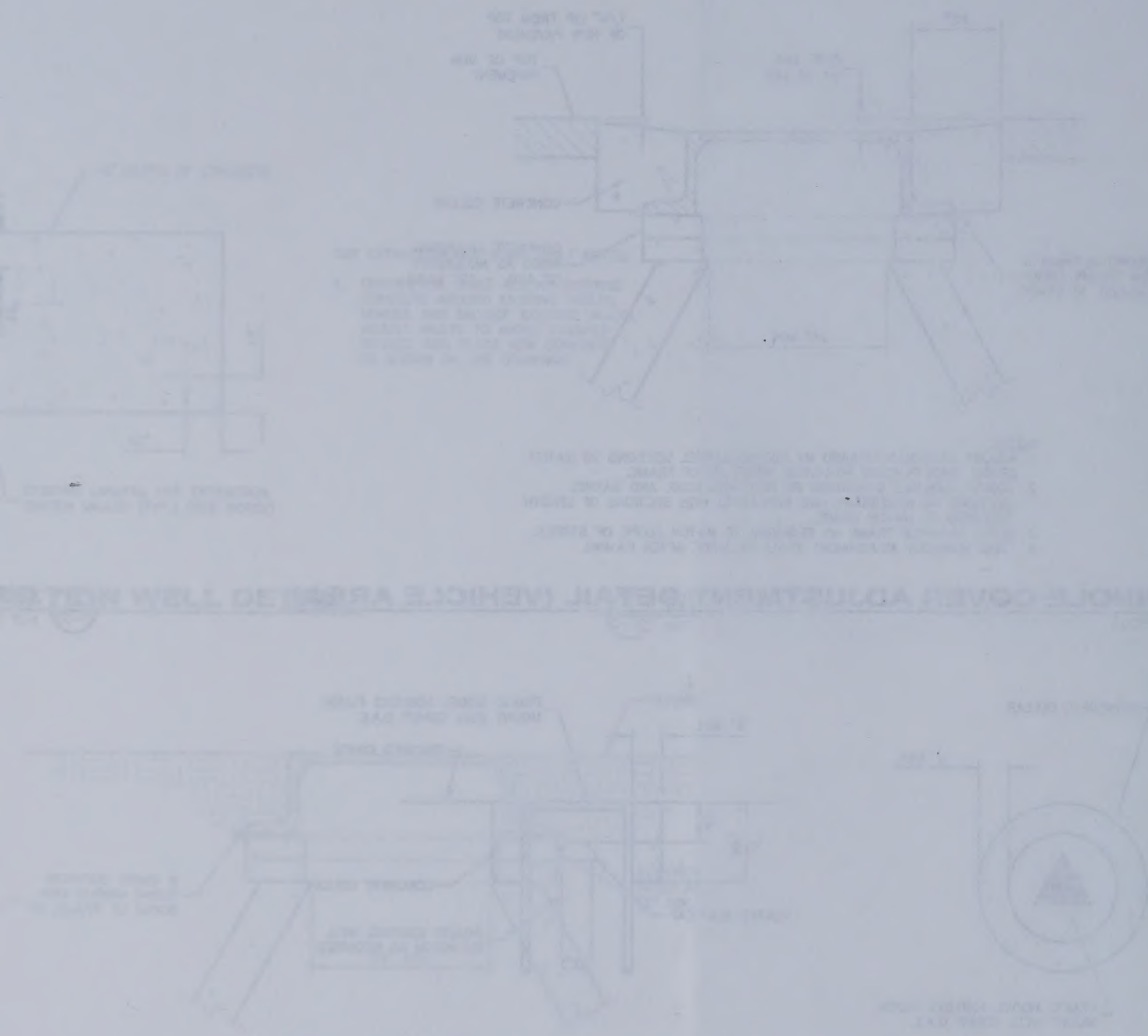
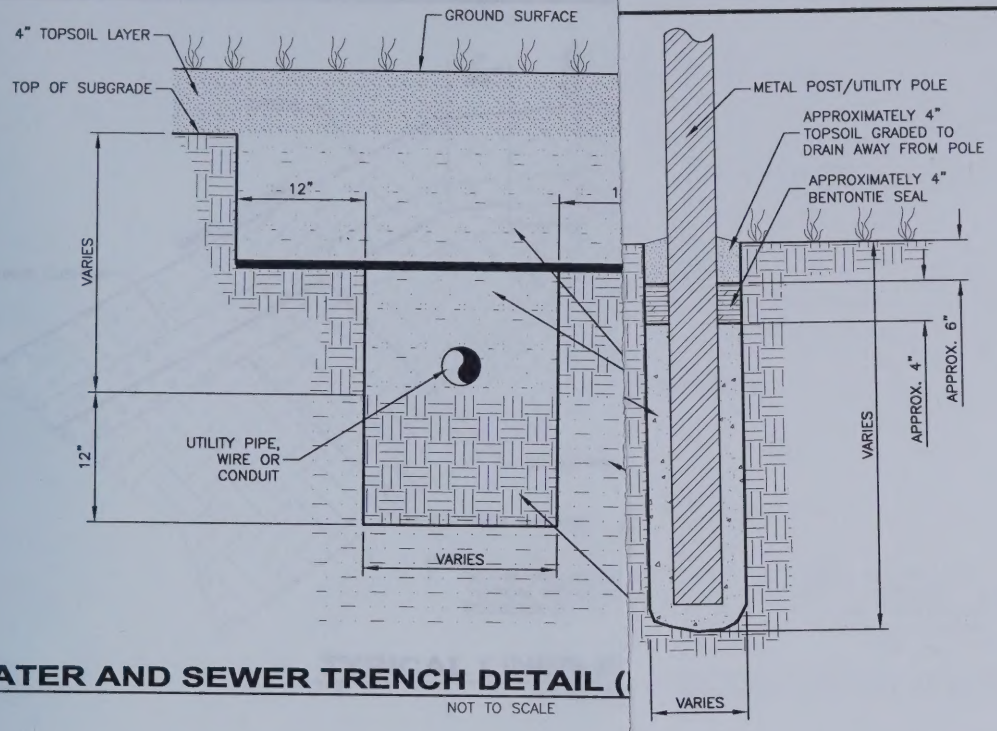


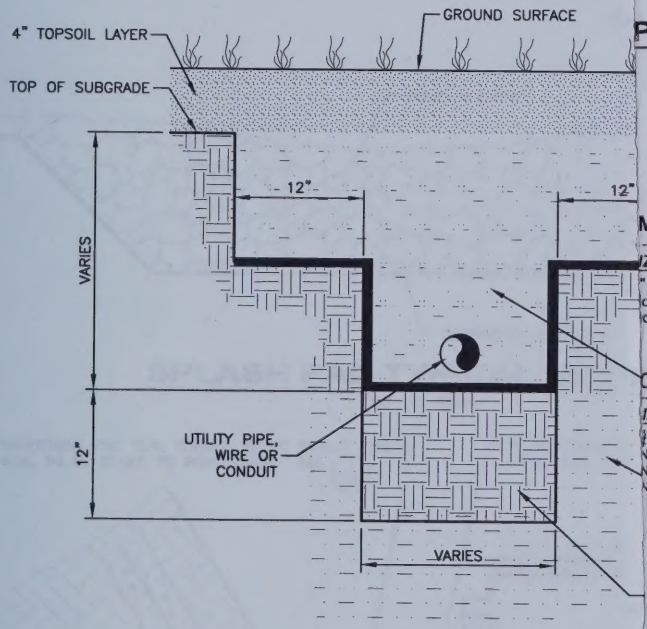


WATER AND SEWER TRENCH DETAIL (

NOT TO SCALE

POST PENETRATION DETAIL

NOT TO SCALE



MINUS FILL GRADATION

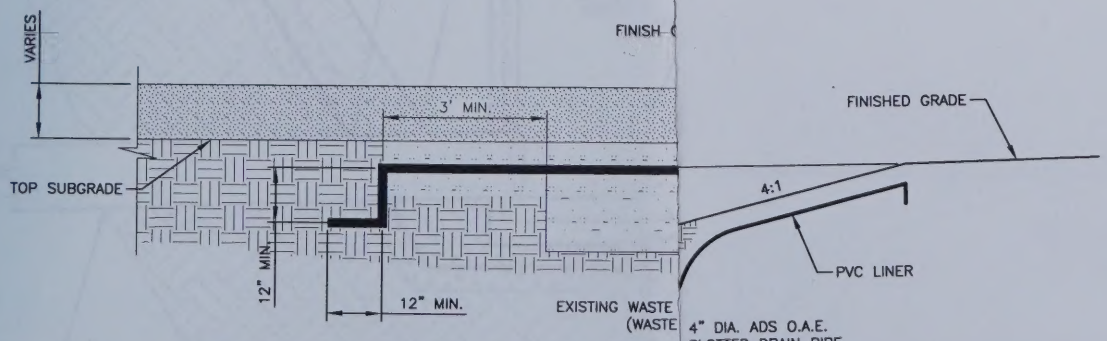
SIZE	% PASSING
"	100
o. 4	60–100
o. 200	15–40

CT FINE GRAINED METERIAL

SIZE	% PASSING
"	100
No. 4	95
No. 40	60
No. 200	40

IRRIGATION TRENCH DETAIL (ENCC

NOT TO SCALE



NOTE:
DETAIL FOR LANDSCAPED AREAS, GRAVEL ROADS, AND DRAINAGE AREAS. DOES NOT INCLUDE ASPHALT AREAS.

TYPICAL GRADING D ECTION

Stamp:

MONTANA
TODD
PRELIMINARY
LICENSED PROFESSIONAL ENGINEER

Logo:

GreatWest engineering
2501 BELT VIEW DRIVE
HELENA, MT 59601
(406)449-8627

Centennial Park - 95% Submittal

LANDFILL CLOSURE DETAILS

CARL THUESEN
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LANDSCAPE ARCHITECTURE
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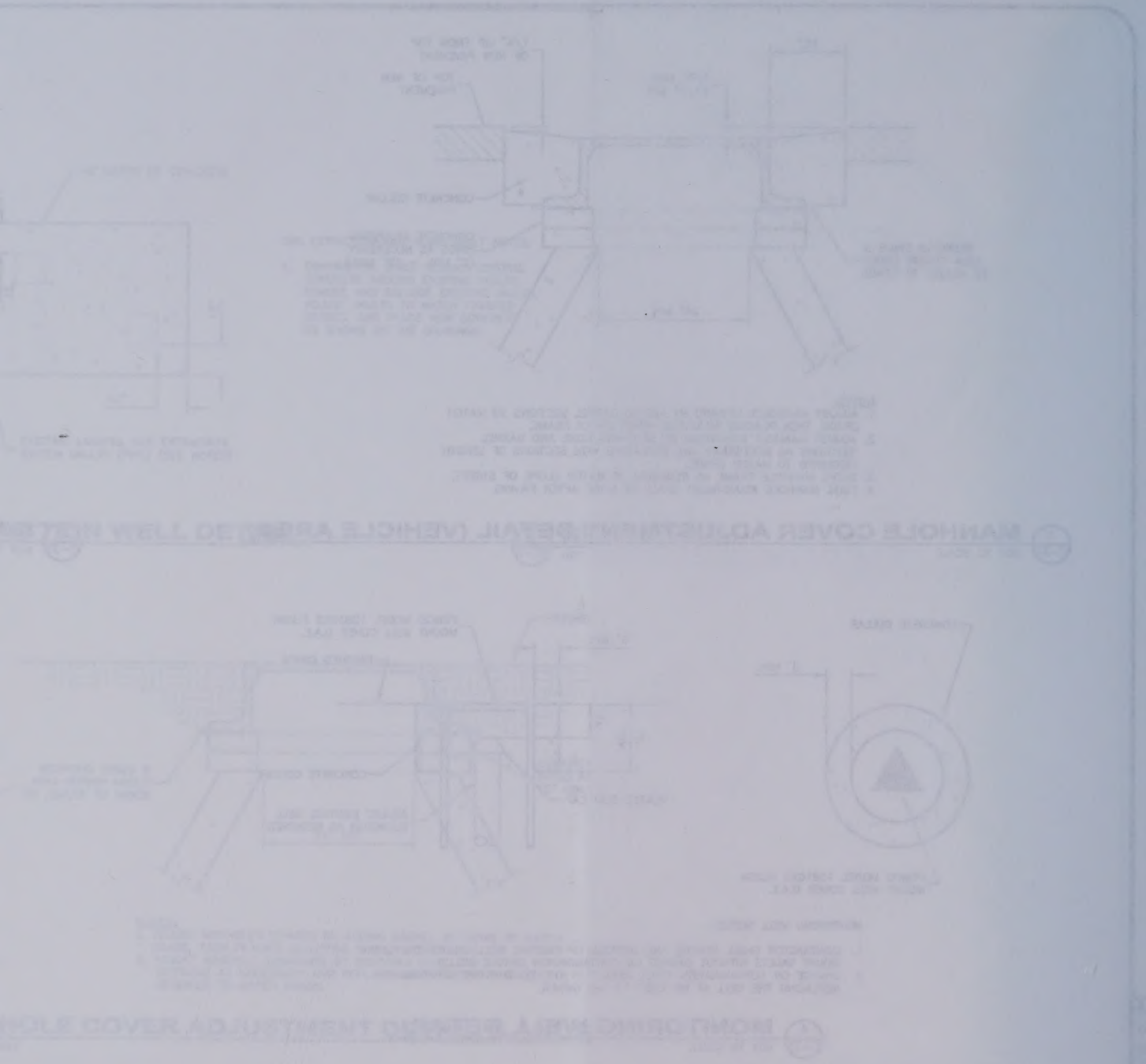
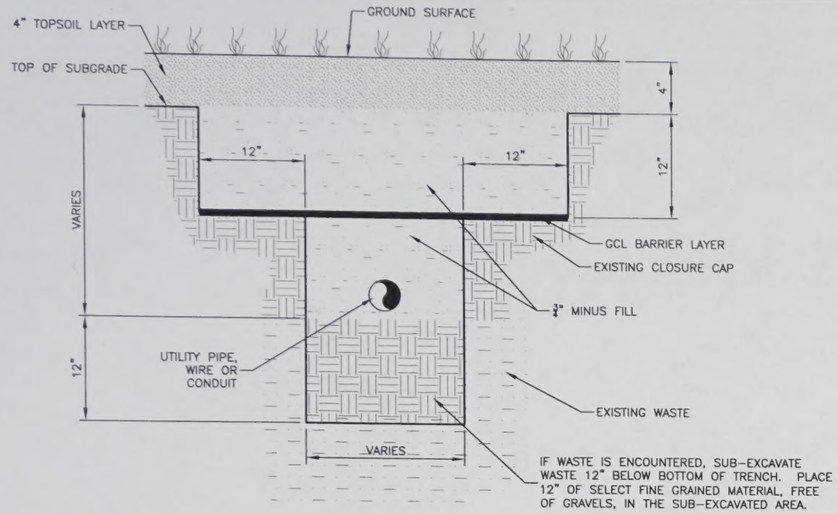
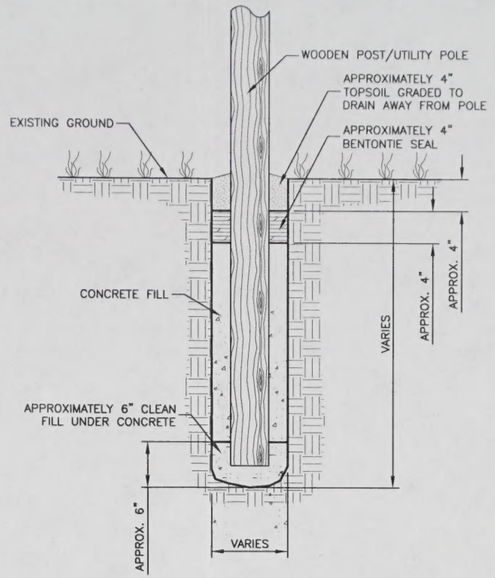




WATER AND SEWER TRENCH DETAIL (ENCOUNTERED WASTE)

NOT TO SCALE



TYPICAL WOODEN POST PENETRATION DETAIL

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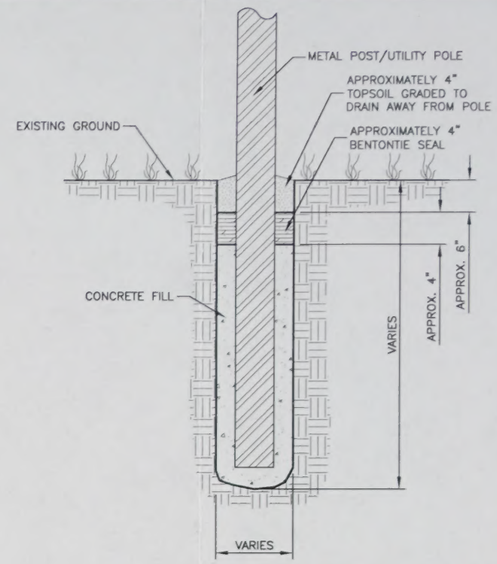

TYPICAL METAL POST PENETRATION DETAIL

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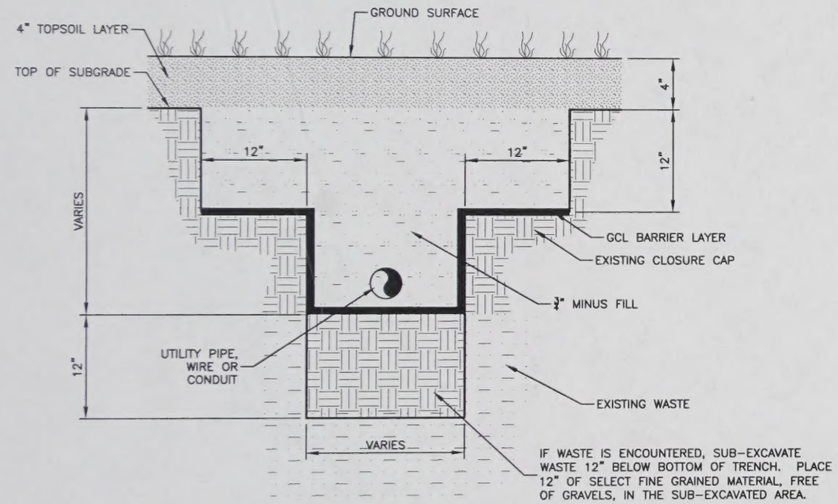

IRRIGATION TRENCH DETAIL (ENCOUNTERED WASTE)

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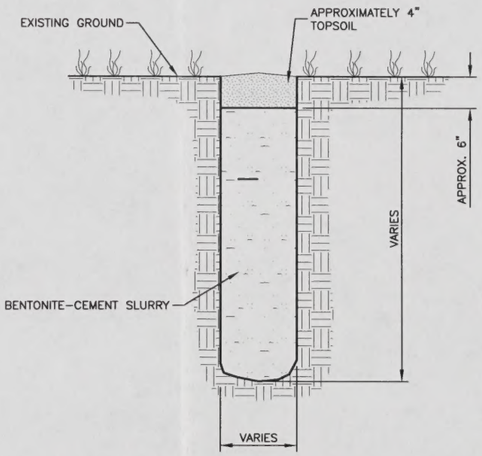


TYPICAL POST HOLE REMEDIATION DETAIL

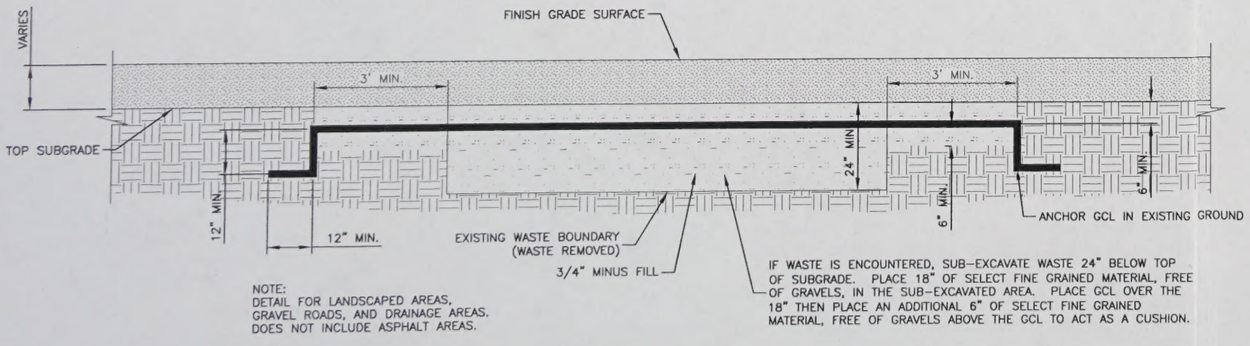
NOT TO SCALE

¾" MINUS FILL GRADATION

SIZE	% PASSING
¾"	100
No. 4	60–100
No. 200	15–40

SELECT FINE GRAINED METERIAL

SIZE	% PASSING
¾"	100
No. 4	95
No. 40	60
No. 200	40



TYPICAL GRADING DETAIL (ENCOUNTERED WASTE)

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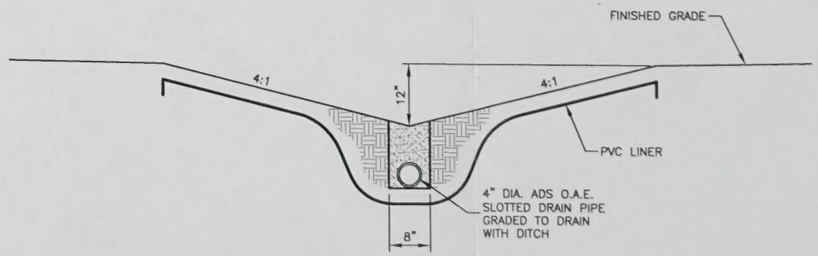

TYPICAL DITCH SECTION

NOT TO SCALE

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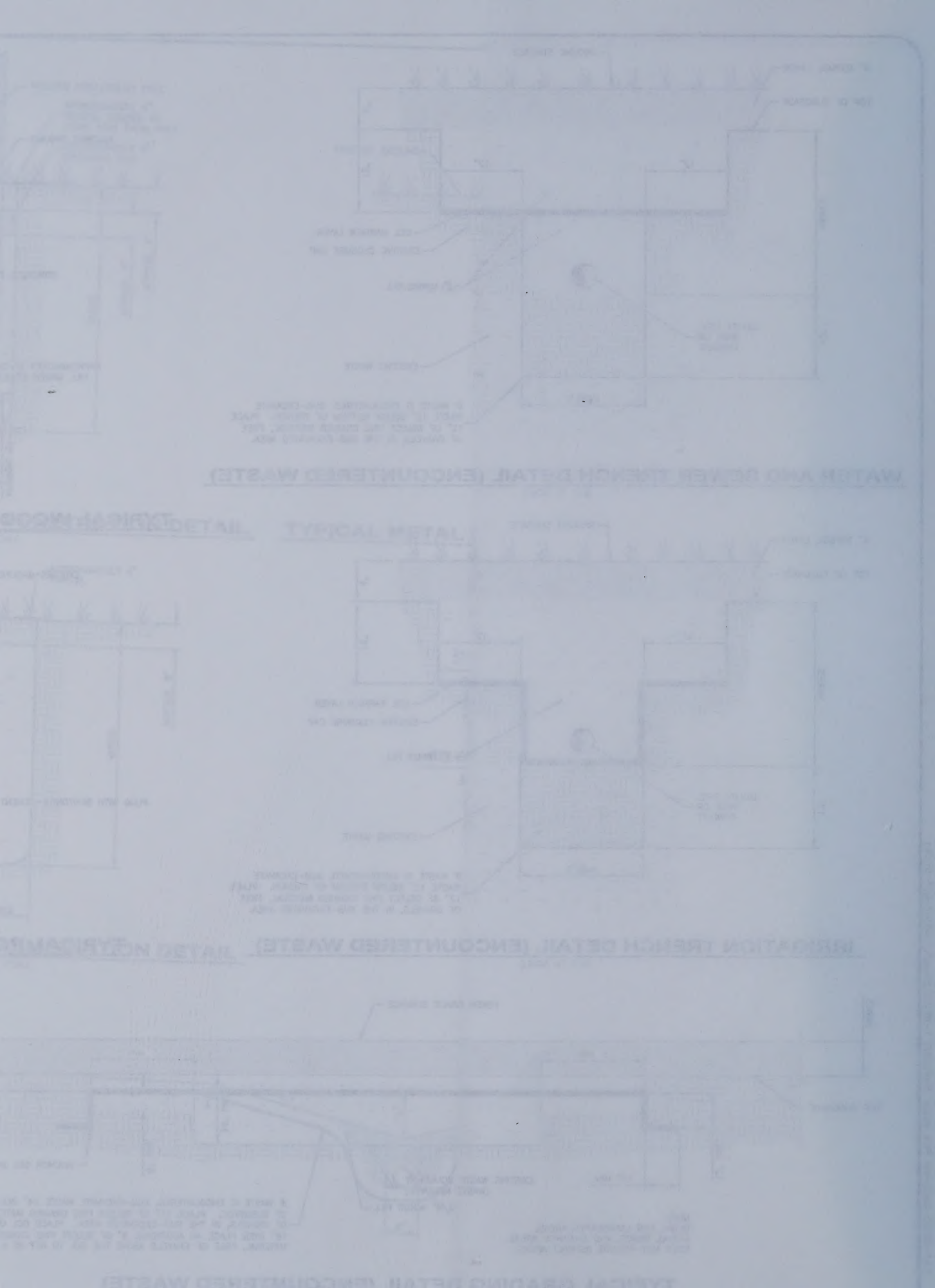
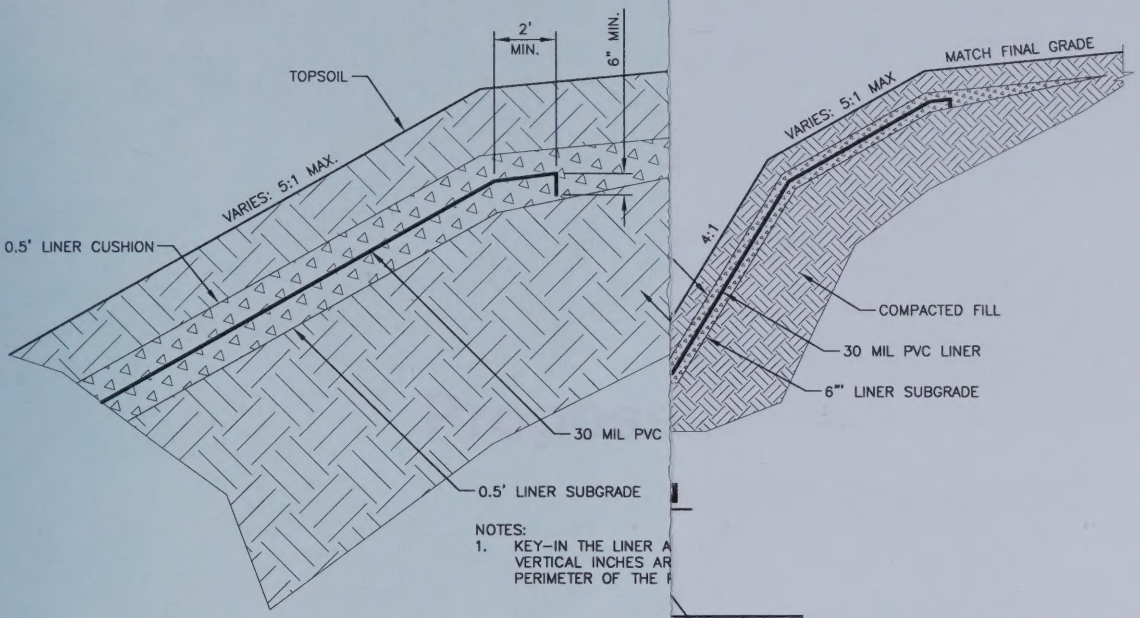
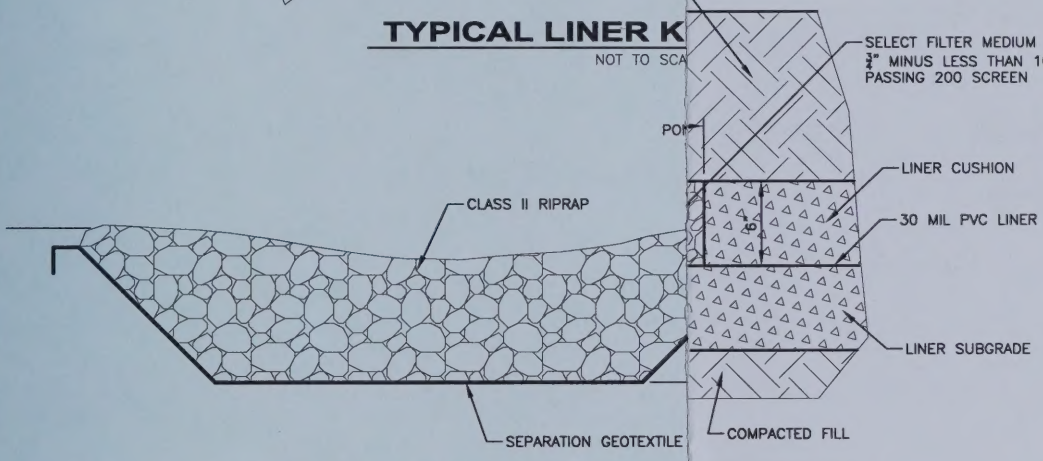




NOTES:
1. KEY-IN THE LINER A
VERTICAL INCHES AR
PERIMETER OF THE

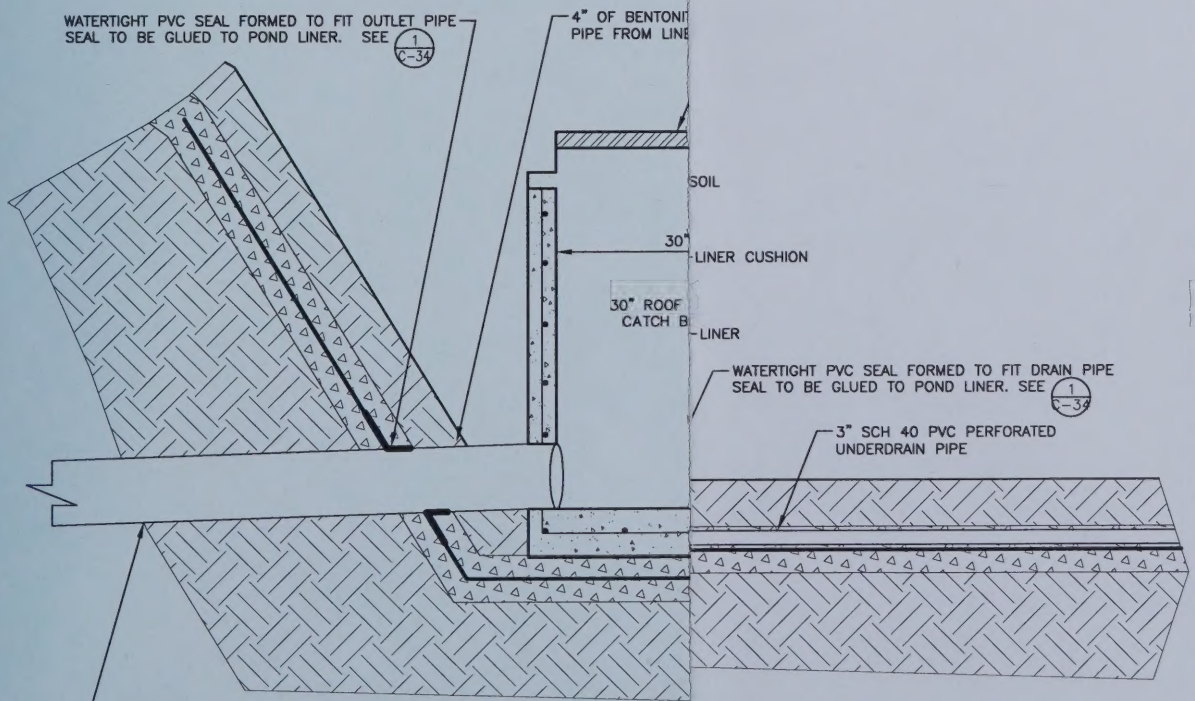
TYPICAL LINER K

NOT TO SCA



SPLASH PAD TYPICAL SEC PE DETAIL

NOT TO SCALE



NOTE:
1. CONTRACTOR TO PROVIDE INLET
FABRICATED FROM #4 REBAR.
HAVE MAXIMUM OPENING SIZES

UNDERDRAIN PIPE WITHIN
N SECTION.

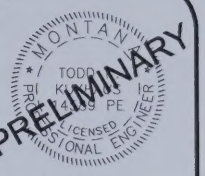
OUTLET STRUCTURE

NOT TO SCALE

DRAIN PIPING

NOT TO SCALE

Stamp:



Logo:

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STORMWATER DETENTION POND DETAILS

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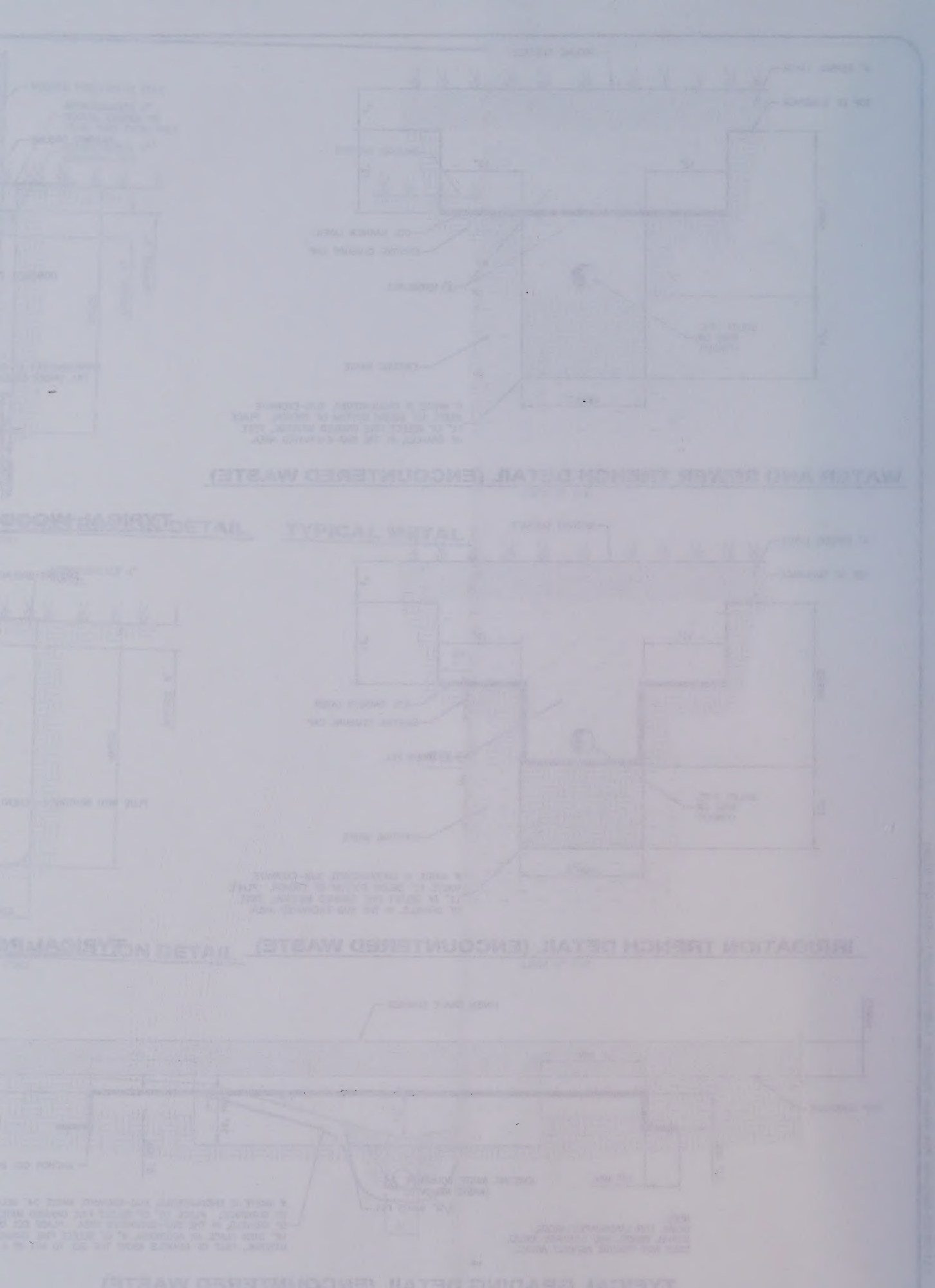
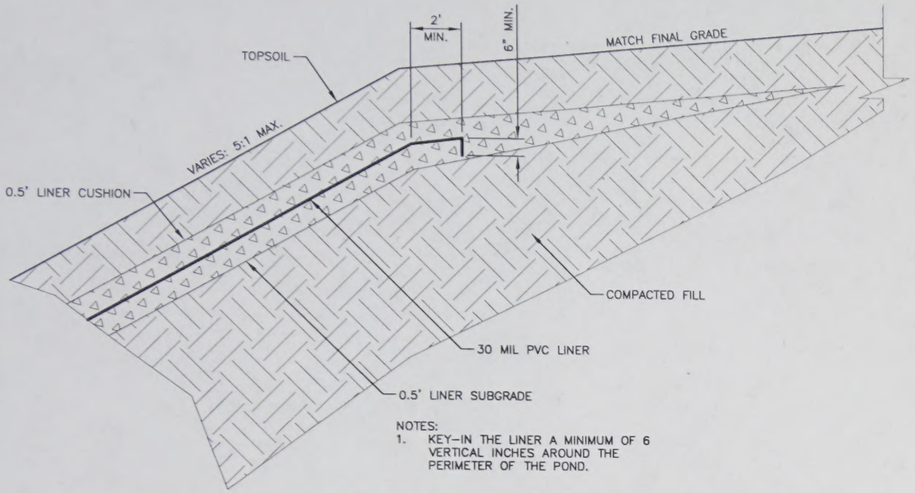
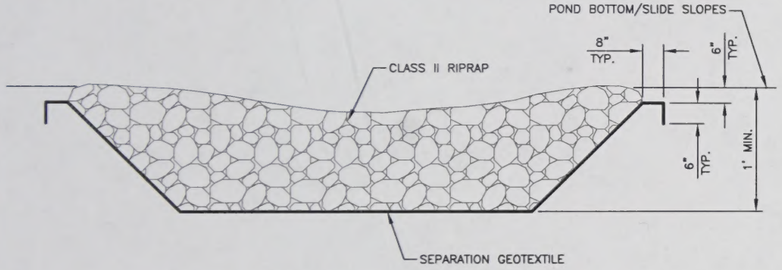


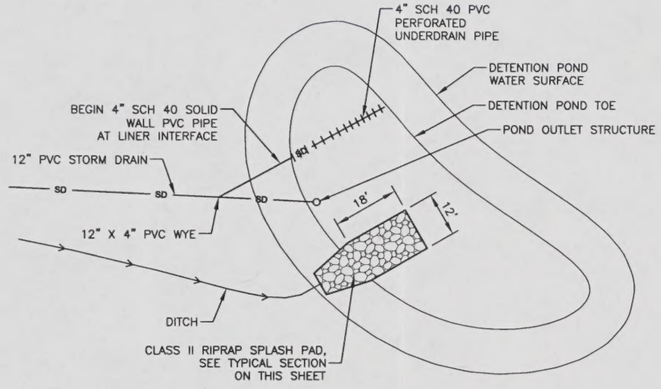


NOTES:
1. KEY-IN THE LINER A MINIMUM OF 6 VERTICAL INCHES AROUND THE PERIMETER OF THE POND.

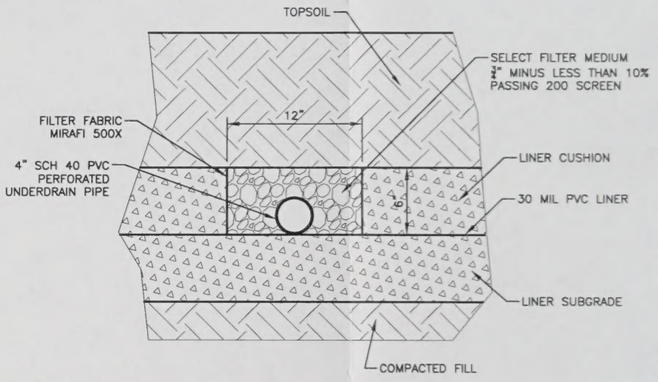
TYPICAL LINER KEY-IN DETAIL
NOT TO SCALE



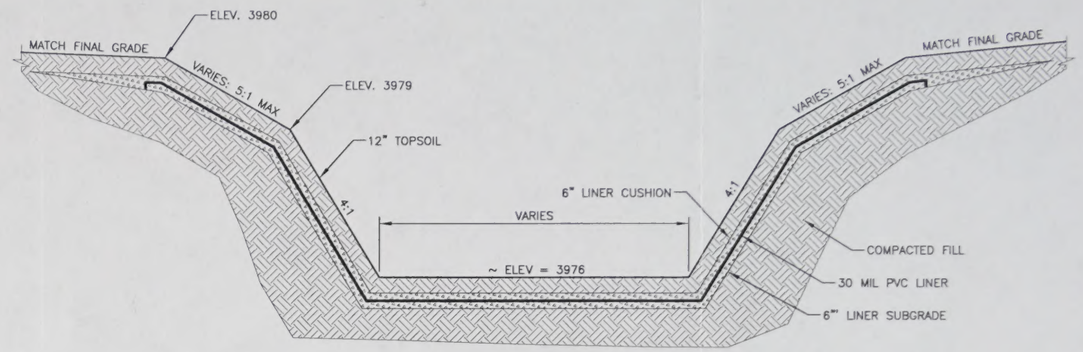
SPLASH PAD TYPICAL SECTION
NOT TO SCALE



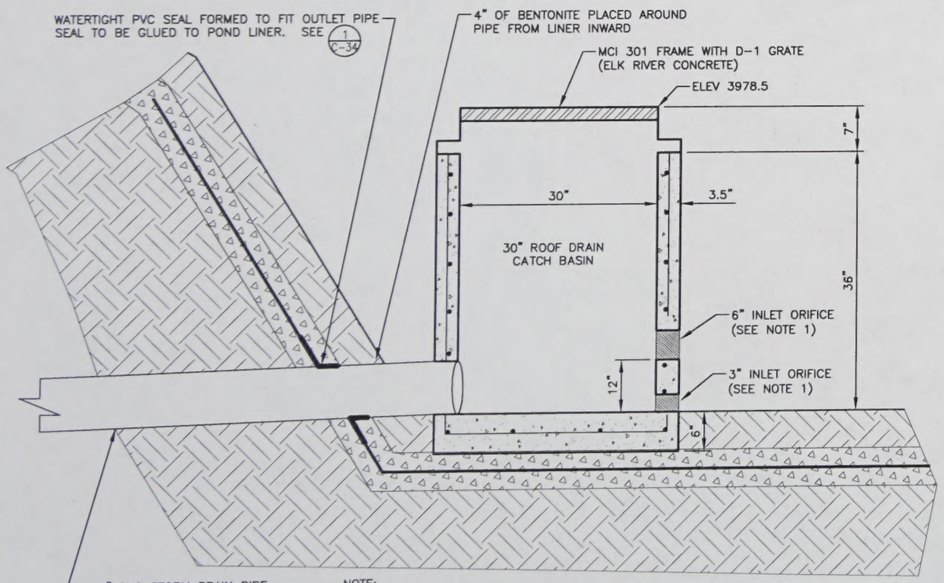
POND OUTLET PIPING DETAIL
NOT TO SCALE



UNDERDRAIN PIPE DETAIL
NOT TO SCALE

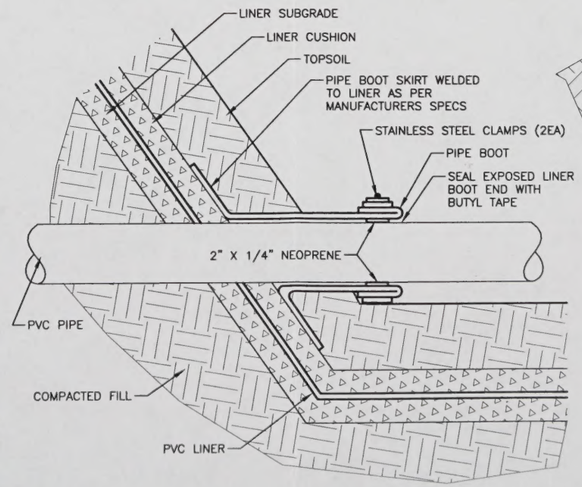


TYPICAL POND SECTION
NOT TO SCALE



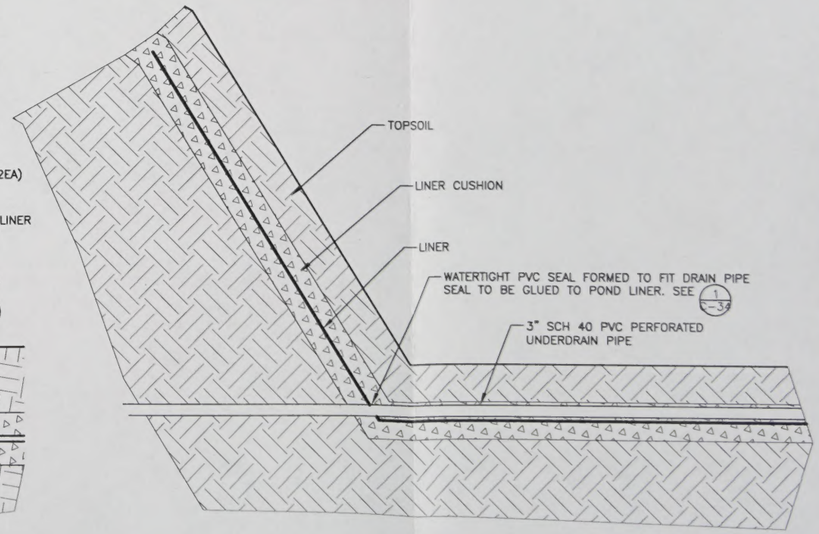
NOTE:
1. CONTRACTOR TO PROVIDE INLET TRASH RACK FABRICATED FROM #4 REBAR. RACK SHALL HAVE MAXIMUM OPENING SIZES OF ONE INCH.

OUTLET STRUCTURE AND PIPING
NOT TO SCALE



NOTES:
1. PREFORM PIPE BOOT AS SHOWN
2. ALL LINER PENETRATIONS TO BE AS PER MANUFACTURERS SPECIFICATIONS

1/C-34 LINER PENETRATION DETAIL
NOT TO SCALE



NOTES:
1. PLACE UNDERDRAIN PIPE WITHIN CUSHION SECTION.

UNDERDRAIN PIPING
NOT TO SCALE

Stamp: MONTANA TODD KUNKEL 9 PE LICENSED PROFESSIONAL ENGINEER PRELIMINARY

Logo: GreatWest engineering 2501 BELT VIEW DRIVE HELENA, MT 59601 (406)449-8627

Centennial Park - 95% Submittal

STORMWATER DETENTION POND DETAILS

CARL THUESEN A S L A
GOLF COURSE ARCHITECTURE
LANDSCAPE ARCHITECTURE
1925 GRAND AVE. SUITE 105
P.O. BOX 22943
BILLINGS, MT 59104
406/252-5545 FAX 245-9855

Drawn by:	BAA
Date:	11/18/09
Checked by:	TKK
Date:	11/18/09
Rev:	
Rev:	
File:	

SHEET C-34

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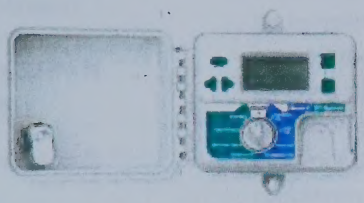
Appendix B

Proposed Irrigation Controls

Hunter®
The Irrigation Innovators

ET System

Gathers weather data on site, continuously calculates the ideal program for your landscape



ET System Module

ET System Sensor
(Shown with optional ET WIND)

Take the guesswork out of residential irrigation scheduling, by tracking your local microclimate and automatically calculating a scientific irrigation program! The Hunter ET System is an easy-to-add-on accessory (for any Hunter controller that operates with a SmartPort® system) that measures key climatic conditions, and uses them to calculate your local Evapotranspiration (ET) factor. The ET is then downloaded into your irrigation controller to create an irrigation program that is just right for your sprinkler system, plants, and soil conditions. By taking into account the rate at which water is consumed by weather conditions, the ET System will initiate a new schedule to replenish only the water that is actually needed. And our WiltGard™ technology can intervene to trigger protective watering when extreme conditions threaten your plants. The result can be a dramatic savings in your water bill (about 30%, on average), healthier root zones, and your participation in conserving our precious natural resources.

PROVEN WATER SAVER

Features & Benefits

Calculates Evapotranspiration (ET) for your local microclimate

Automatically creates a scientific program and downloads it to your standard controller

Saves water and money

Minimizes water waste, applies just the water your plants need

WiltGard™ technology

Enables it to trigger protective watering when extreme conditions threaten your plants

True station-specific database determines appropriate watering

ET information combines with each zone's particular plant, soil, sun, and sprinkler data

Easily upgrades most Hunter controllers to weather–based control

No high voltage AC wiring required

Non-volatile memory

Retains your program and site information in event of a power failure

SWAT™ Performance Summary and Technical Report now available at www.irrigation.org

Weather Data at Your Site (Not from Somewhere Else)

Hunter's ET System requires ***no subscription fees****, and is not based on any form of broadcast or other distant weather data. Your irrigation schedule is based on actual conditions in your landscape. The ET System was designed to exceed standards developed by the Irrigation Association and government agencies, using* ***Smart Water Application Technology*** *to minimize waste, while creating healthier landscapes.*

Models

ET SYSTEM – ET Sensor with outdoor interface ET Module

ET WIND – Optional anemometer for wind speed

Dimensions

- ET Module – 6" H x 4" W x 1.75" D (153 mm H x 102 mm W x 45 mm D)
- ET Sensor – 10½" H x 7¼" W x 12⅜" D (26.7 mm H x 18.4 mm W x 30.8 mm D)
- ET Sensor with pole brackets – 10½" H x 7¼" W x 13" D (26.7 mm H x 18.4 mm W x 33.0 mm D)
- ET Sensor with ET Wind – 11½" H x 7¼" W x 19⅞" D (29.2 mm H x 18.4 mm W x 50.5 mm D)
- ET Sensor and ET Wind with pole brackets – 11½" H x 7¼" W x 20¾" D (29.2 mm H x 18.4 mm W x 52.7 mm D)

Specifications

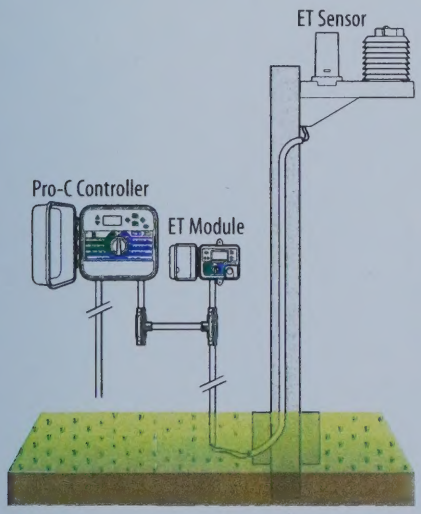
- 48 station maximum
- Power Input: 24 VAC, 50/60Hz (from host controller)
- Current draw: 20 mA, max
- Non-volatile memory
- Replaceable 10-year lithium battery
- Wiring:
  ET Module power, SmartPort
  ET Sensor, 2 x 18 AWG/1 mm
- Max distance, ET Module from controller: 6 ft./2 m
- Max distance, ET Sensor from module: 100 ft./30 m

Upgrade any of These Standard Hunter Controllers to Weather-based Control

SRC/SRC *Plus* Controllers

Pro-C Controllers

ICC Controllers



The ET Sensor can be conveniently wall or pole mounted up to 100 feet away from the ET Module.

No More Sprinklers Running in the Rain!

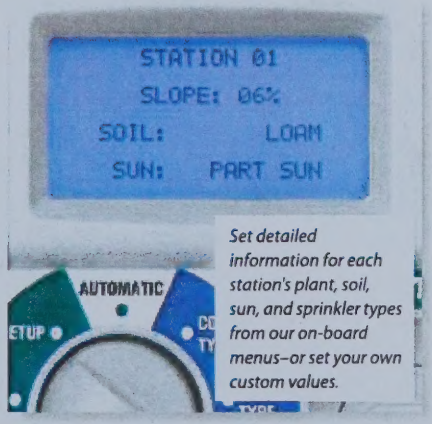
Each ET System has a simple user interface, so you can select from a menu of common sprinkler, plant, and soil types, or create your own custom factors. The system's sensor array includes solar radiation, relative humidity, temperature, a rain gauge that tracks precipitation, plus an optional anemometer for wind speed. The ET System stops wasteful irrigation after naturally occurring rainfall, and automatically resumes sprinkler operation when conditions return to dry.

ET and Irrigation: Working with Climate

Plants evaporate moisture through their leaves, and replenish it through their roots. In turn, conditions such as temperature, humidity, and wind dictate the rate at which the plants lose their moisture. ET-based irrigation measures these conditions and replenishes only the amount of water lost to plant evaporation. Factors such as the precipitation rate of your sprinklers, the crop coefficient of your plant types, and the infiltration rate and holding capacity of your soils are taken into account with simple menu selections.

Evapotranspiration and Hunter: Leading the Way

Evapotranspiration is a formula, based on weather conditions, which has been created through exhaustive research and experimentation by irrigation professionals. ET has come to symbolize the "best practice" for determining landscape watering needs. Hunter helped to pioneer this field of automatic irrigation, and has offered ET-capable controllers for over 15 years. Now, the ET System brings this proven technology to a simple, affordable package that lets all of us irrigate responsibly.



Set detailed information for each station's plant, soil, sun, and sprinkler types from our on-board menus–or set your own custom values.

SPECIFICATION GUIDE

EXAMPLE: **ET SYSTEM**

MODEL

ET SYSTEM = ET Sensor with outdoor interface ET module, for direct connection to Hunter SmartPort™ enabled controllers

ET WIND = Optional anemometer for wind speed

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www.HunterIndustries.com

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P/N 701011 LIT-396 5/07

Appendix C

Tree Root Depth and Irrigation Requirements

THEORETICAL PLANT WATER REQUIREMENTS

COMMON NAME	BOTANICAL NAME	PLANT FACTOR	DIA	AREA (SF)	*GPD (EA.)
COLORADO SPRUCE	PICEA PUNGENS	0.8	20	314	83
NORWAY SPRUCE	PICEA ABIES	0.8	20	314	83
AUSTRIAN PINE	PINUS NIGRA	0.8	20	314	83
AMUR MAPLE	ACER GINNALA 'FLAME'	0.8	15	177	47
CANADA RED CHOKECHERRY	PRUNUS VIRGINIANA 'CANADA RED'	0.8	15	177	47
TATARIAN MAPLE	ACER TATARICUM	0.8	15	177	47
SIOUXLAND COTTONWOOD	POPULUS DELTOIDES 'SIOUXLAND'	0.8	35	962	254
HACKBERRY	CELTIS OCCIDENTALIS	0.8	40	1257	332
PATMORE ASH	FRAXINUS PENNSYLVANICA 'PATMORE'	0.8	35	962	254
PRAIRIEFIRE CRAB	MALUS 'PRAIRIEFIRE'	0.8	15	177	47
SPRING SNOW CRAB	MALUS 'SPRING SNOW'	0.8	15	177	47
SWAMP WHITE OAK	QUERCUS BICOLOR	0.8	30	707	187
GREENSPIRE LINDEN	TILIA CORDATA 'GREENSPIRE'	0.8	35	962	254
REDMOND LINDEN	TILIA AMERICANA 'REDMOND'	0.8	35	962	254
MORTON GLOSSY ELM	ULMUS GLABRA X TRIUMPH 'MORTON GLOSSY'	0.8	40	1257	332
AUTUMN SPLENDOR HORSECHESTNUT	AESCULUS X ARNOLDIANA 'AUTUMN SPLENDOR'	0.8	35	962	254
MAYDAY TREE	PRUNUS PADUS COMMUNTATA	0.8	20	314	83

* Gallon per day (GPD) based on mature size.

Trees located in irrigated turf areas will be irrigated with the turf irrigation system and will typically only receive a portion of the amount shown. Trees that are located in non-irrigated areas will be hand watered until established and then water will be minimal.

Root Depth:
The majority of tree roots are located within the top 6 - 24 inches of the soil and do not usually grow deeper than 3 - 7 feet. Roots grow where the water, nutrients, and oxygen are found. Because of this, the potential for roots being found deeper than 24 inches is minimal. The clay cap over the landfill will also act as a barrier for any roots that may be deeper than 24 inches. When roots come in contact with something impermeable such as the clay cap, they will typically grow in a lateral direction where the soil is less compact and less restrictive to growth.